The Dock and Harbour Authority

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Editorial Comments

Newcastle-upon-Tyne.

The castle, designated as "new" in the name of the important city and port, which is the subject of this month's leading article and illustrated supplement, actually dates from the Twelfth Century, and like some other mediæval creations, such as the New Forest, has retained an out-of-date appellation through a long period of time. In its curtailed and dismantled state, it is still a striking illustration of a fine Norman stronghold, reputed to have been the stoutest fortress in the North of England and an impregnable barrier against border invasion.

Indicative as it is of the antiquity and historical dignity of the place, it is not so much for this aspect of its importance that Newcastle claims our attention in the current issue. It is because the locality is the heart and centre of a great shipping and industrial region, known somewhat vaguely but comprehensively as the North-East Coast, which embraces the Northumberland and Durham Coalfield and, along the sinuous course of the Tyne, a congeries of active communities: Tynemouth, North and South Shields, Jarrow, Gateshead and Newcastle itself.

The Tyne, in fact, is the main arterial waterway of what in former times used to be a busy and thriving district resounding with the clang of hammers, the fusillade of rivetting machines and the noisy cascades of coal falling into ships' holds. Shipbuilding, iron and steel works and the coal trade were the great activities of the place and the deterioration which has taken place in recent years along the banks of the river has been pitiful and depressing to witness. Empty slipways, deserted yards, rusty and dilapidated structures bear witness to the havoc wrought by the insidious evil of trade depression. But the inhabitants are a hardy and courageous race and with characteristic energy, implementing the measures taken by the Government by way of subsidy and encouragement, the authorities along the banks of the Tyne are planning, rebuilding and re-shaping the disorganised and dismantled equipment to enable fresh enterprises to be undertaken and productive outputs once more to be achieved. Some of these developments are described by Mr. R. F. Hindmarsh, Chief Engineer of the Tyne Commission, in his interesting article.

A notable achievement of the Tyne, an appropriate recollection at the moment, was the construction of the old "Mauretania," which, launched in September, 1906, maintained a supremacy in the Atlantic passenger service for twenty years and then in her twenty-first year, reconditioned and overhauled, contested the right to the premier place with the newly-constructed German liner "Bremen," actually beating her own previous record in doing so. But other vessels, no less remarkable, have had their origin in the Tyne slipways—such fine battleships as the "Queen Mary," the "Malaya" and the "Nelson." The naval yard at Walker is world-renowned for its output. Furthermore, there are the great armaments of the works at Elswick, where the Armstrong gun was created, and the name of Newcastle is inseparably linked with the birth and development of Parson's steam turbine.

In recounting these achievements of local firms, we must not overlook the enterprise of the Commissioners themselves who, through their successive engineers, have made the Tyne capable of the performance of such feats. Like the Clyde, the subject of our last month's leading article, the Tyne was, in its natural state, a shallow, winding stream, beset at its entrance by sandbanks and a bar. The bar has been removed, and, protected now by two outlying breakwaters from the swell of heavy seas, the entrance channel has been dredged and improved until vessels drawing from 31-ft. to 33½-ft. can enter and leave the river on ordinary high tides and there is a standard depth of about 30-ft. at low water from the sea to Northumberland Dock, a distance of over three miles.

The development of the coal trade of the port has been rather remarkable, the shipments having been quadrupled within a period of half-a-century. The regrettable set-back experienced lately will, it is hoped, only prove temporary and no doubt there will be an early resumption of the upward trend. Oil is also receiving considerable attention, and further provision is being made for the storage of supplies with facilities for shipment. The omens are propitious and there is every ground for believing that the present efforts to resuscitate the fortunes of the Northern port will be crowned with success.

Proposed Tyneside Port Authority.

Almost coincident with the appearance of the article on the Tyne, there has been announced a movement towards what appears to be a desirable and judicious development in local port administration. The jurisdiction over riverside interests has hitherto been somewhat disjointed as between the Tyne Improvement Commissioners, the City Corporation of Newcastle and the various urban authorities along the river. On the 26th May last, the Commissioners, in considering an answer of the Minister of Transport to a question previously tabled in the House of Commons, laid down the following statement of their policy:—

They are prepared to become the Tyne Port Authority for the ownership and control of all docks, quays and staiths used for the loading and discharging of all descriptions of cargoes in the River Area over which the Commissioners' jurisdiction at present extends, if—

(1) There is a substantial measure of agreement amongst the Municipal Authorities on both banks of the river, and any other proprietary interests involved, as to the terms and conditions of acquisition.
Provided that if such agreement be reached and the Commissioners promote the necessary legislation to effect the transfer—the Ministry of Transport agree in principle to support such legislation in both Houses of Parliament.

(2) The Ministry of Transport take the initiative of summoning a Conference of all the interests concerned, at which the Commissioners would nominate some of their members and officials to be in attendance.

If some steps, such as those indicated, can be taken for the amalgamation of the various local jurisdictions over waterside operations on the Tyne, the result should be all to the good. There is undoubtedly scope for greater uniformity and unity of action, and conflicting interests would be largely eliminated. The success of the Port of London Authority in replacing the independent dock and river authorities on the Thames is a notable object lesson in the advantages to be gained by local amalgamation of this kind.

The Air Port of Southampton.

A comment which we made recently, in connection with the inauguration of the Aerodrome of the Belfast Harbour

Editorial Comments—continued

Commissioners, that port authorities would have to concern themselves in an increasing degree with the provision of suitable accommodation for air craft, finds an exemplification in the announcement that the Southampton Harbour Board have agreed to surrender to the Air Ministry a stretch of water, one mile in length and 1,200-ft. in breadth, on the Eastern side of Southampton Water near Netley Castle, for the purpose of a terminal for an Empire Air Service. Already the Imperial Airways have been using Southampton as a temporary base, pending a decision on the relative advantages of a terminal at Portsmouth and at Southampton. Portsmouth authorities have manifested some reluctance to incur the necessary expense of adapting an area in Langstone Harbour, and the choice of Southampton apparently closes the negotiations in that direction.

At Southampton, it was essential to make arrangements to secure complete freedom for commercial shipping and some control of aircraft, is therefore necessary. The Air Ministry, accordingly, have come to terms with the Harbour Board, so that the latter may obtain statutory powers to reserve the area as a licensed water aerodrome. A system of control is to be devised for the operations of aircraft by day and night, and it will be administered by an officer of the Ministry, in consultation with the harbour master, or his representatives.

A certain amount of dredging will be required to prepare the site for the reception of aircraft and this will be undertaken by the Air Ministry.

The establishment at Southampton of an Empire Air Base is particularly interesting in the light of the recent quayage extensions at the port for the accommodation of transatlantic liners. The development in the range and speed of aircraft has been so stupendous of late and continues at so rapid a pace, that it does not require much effort to foresee in the near future a keen rivalry for supremacy, between the aeroplane and the ship, in regard to an important part of the world's passenger services.

The Port of Wisbech and the River Nene.

At the recent annual inspection of the Port of Wisbech and its approaches, Alderman F. J. Hobourn, Chairman of the Port and Harbour Committee of the Wisbech Corporation, made a statement on the improvements effected in the navigable waterway both below and above the town and the better means of access to the port, in connection with which he paid a tribute to the initiative of Captain L. D. Price, the Harbour Master, and to the work of the River Nene Catchment Board. Emphasising the fact that the Borough Council is the navigation authority from the sea to Bevis Hall (about 2 miles above Wisbech) " with ancient and powerful Acts behind us," and that the Catchment Board is the drainage authority for the whole river, " with the Land Drainage Acts behind them," he commented on the harmonious relations which prevailed between the two bodies, as exemplified by " the give and take which had been shown on both sides."

It is fortunate for the locality that so happy a state of affairs exists, for duality of jurisdiction does not always lead to such " easy working." Indeed, it may sometimes result in rather awkward deadlocks on important questions. Furthermore, it may be urged that since the functions of a Catchment Board are essentially concerned with land drainage, it is a little incongruous for such a body, acting under the control of the Minister of Agriculture, to deal with matters affecting navigation, which require specialised knowledge in an entirely different field. Still, it has to be admitted that the situation, though anomalous, has been to some extent inevitable. The navigational functions for the upper reaches of the river, that is, above Bevis Hall, were not assumed or appropriated, by the River Nene Catchment Board, but were inherited from the previously existing River Nene Navigation Commission, whom they superseded.

The question of the suitability of Catchment Boards to control and administer the navigation of rivers is rather too complex to examine in this column, but the point was recently raised in the discussion at the Institute of Transport on Mr. Cadbury's Paper on " The Economic Future of Canals," when various views were expressed, including those of Mr. George Dallas, the Chairman of the Nene Catchment Board. A report of this discussion was given in the issue of this Journal for April last (Vol. XVII., p. 161).

Newport and the River Usk.

There has recently been some amount of concern on the part of the Newport (Mon.) Harbour Commissioners as to the state of trade at the port. A report prepared by Mr. W. Mordey for the Parliamentary and Improvement Committee and approved by that body on the 14th June last, reviewed the coastwise coal shipments and showed that the decline which has manifested itself during the past decade may be attributed largely to the better shipping facilities available at a neighbouring port. Mr. Mordey concluded that the existing facilities at Newport offer little, if any, scope for developing the coastwise coaling trade, and suggested several courses of action for providing more satisfactory facilities, with the result that the Harbour Commission have instructed the committee to approach the Great Western Railway Company and the Monmouthshire colliery companies with a view to the installation by them of additional riverside coaling appliances, so that cargoes of coal to Portishead, at present loaded at Penarth and Ely Harbours, may be attracted to Newport.

Arising therefrom, another matter which has been under consideration was the question of deepening the River Usk and a report was received on the subject prepared by Captain Beedie, the Harbour Master, Mr. W. Rhys Williams, the Engineer, and Mr. C. C. Brewer, the Clerk. From an investigation of the entire length of the river from Newport Bridge to the limit of the Commissioners' jurisdiction, it was found that there is adequate depth of water and width in the navigable channel for the vessels using the river wharves, and that no very great benefit would be gained by any scheme for deepening the river, unless advantage were taken of that deepening by the owners of the riverside wharves to lower their berths. This raised the important question as to the depths of piles and foundation levels of quay walls, concerning which little information is available. The Chairman (Mr. M. C. Harrison, Chief Docks Engineer for South Wales under the Great Western Railway) declared that the cost of dredging the River Usk to a depth of 30-ft. at low water ordinary spring tides would be three million pounds, with an annual maintenance charge of between £30,000 and £40,000.

The financial position of the Board has also been examined by a special committee who report that " the income and expenditure account showed a surplus of £353 15s. 0d., compared with a deficiency of £1,419 17s. 0d. for the previous year, which shows that even with a moderate increase in the trade of the port the Commissioners can only just meet their ordinary expenditure from revenue."

The situation is one which undoubtedly calls for careful handling and measures are under consideration which, it is hoped, will have the desired effect of strengthening the Board's financial position.

Lloyd's Register of Shipping.

To anyone associated with shipping affairs in any respect, including, that is to say, port officials and directors, the annual issue of a new edition of Lloyd's Register must be a matter of interest. Naturally, its first appeal is to shipowners and naval architects, but there are features in the volumes which cannot fail to be of service to dock and harbour engineers, such as the very complete and detailed particulars of dry and wet docks, ports and harbours throughout the world. Yet even in the general nature of the compilation there is much to be learned by port officials about the progress and development of the mercantile marine. We cannot refer to all the statistical tables, but one of particular interest is the comparison of steam and motor tonnage throughout the world at June, 1914, and at June, 1938. In Great Britain and Ireland the aggregate tonnage has fallen by 6.4%, while in the British Dominions it has risen by 86.5%, making a net increase of 1% for the British Empire, which is hardly satisfactory in view of the increase of 47.3% in the world total. The United States (sea services) have made the greatest progress with 340.9 % increase, followed by Japan with 193.1%, while Germany, the only case of its kind, has a decrease of 17.6%. There is undoubtedly food for serious reflection in the figures and the meagre increase of the British total is far from satisfactory to those who are concerned for the welfare of the British mercantile marine.

The New " Mauretania."

Although not so spectacular a vessel as either the " Queen Mary " or the " Queen Elizabeth," the " Mauretania," launched from the yards of Messrs. Cammell, Laird and Co., Ltd., of Birkenhead, on July 28th last (an event which took place too late for comment in our last issue) is none the less a notable addition to the transatlantic service and the achievement of her construction is highly creditable to English shipbuilders. Her predecessor, the old " Mauretania," launched from the Tyne yards of Messrs. Swann Hunter and Wigham Richardson, in 1906, was also English built. A comparison of the two vessels is of interest in indicating certain differences in design which have rendered themselves desirable within the space of 30 years. Particularly is this the case in regard to length (772-ft. as against 790-ft.) and the beam (89½-ft. as against 88-ft.).

It will be seen that the length of the new vessel is 18-ft. less than that of the old, though the beam is slightly more in the new. The ratio of length to beam in merchant ship design has shown a decreasing tendency for some time, and whereas at one time it was about 10 to 1, at present it approximates to 8½ to 1. This ratio is, of course, important to dock engineers, in determining the dimensions of tidal entrance locks.

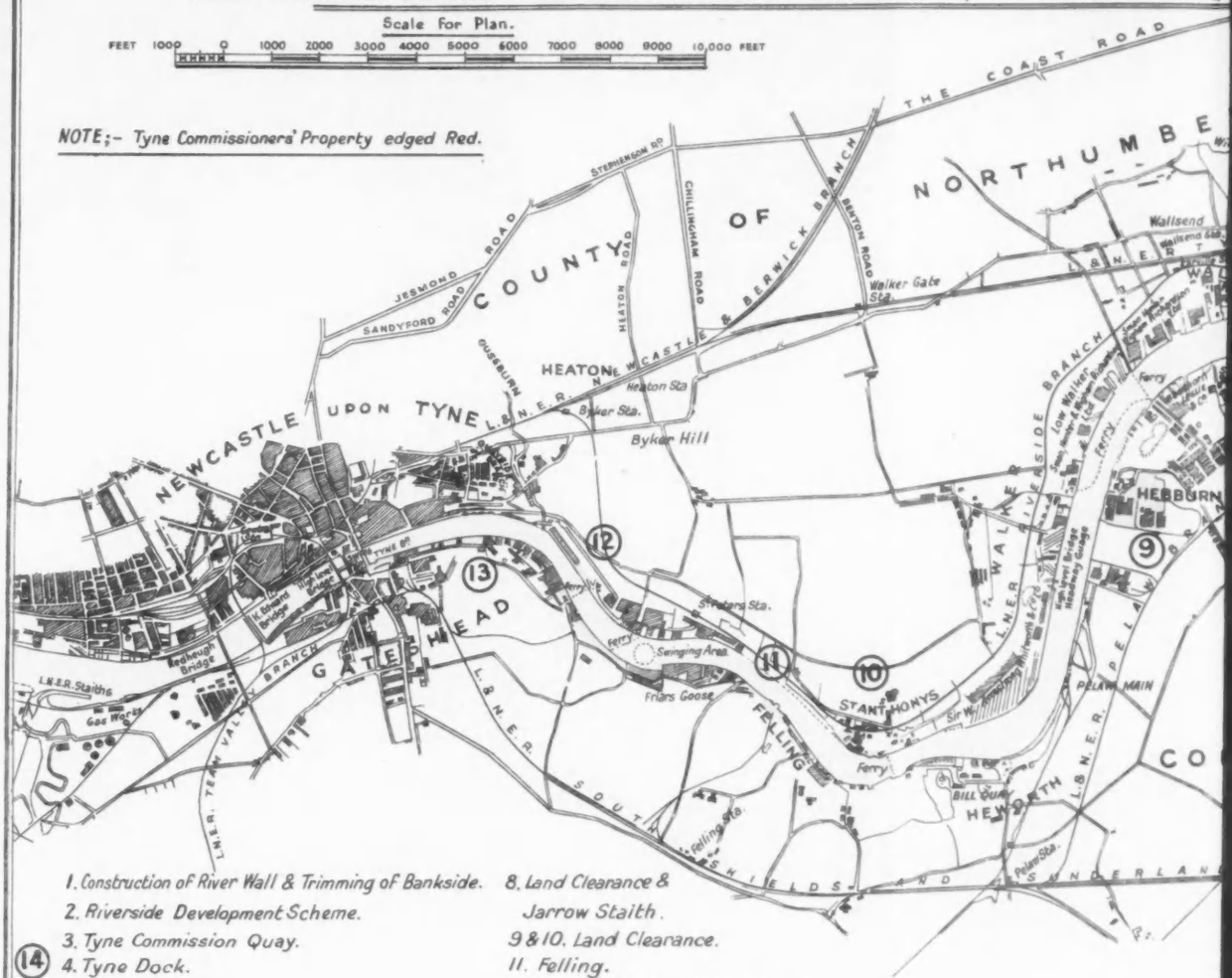
PORT OF NEWCASTLE-UPON

CHIEF ENGINEER TO THE TYNE IMPROVEMENT COMMISSION;-R.F. HINDMARSH, Esq.

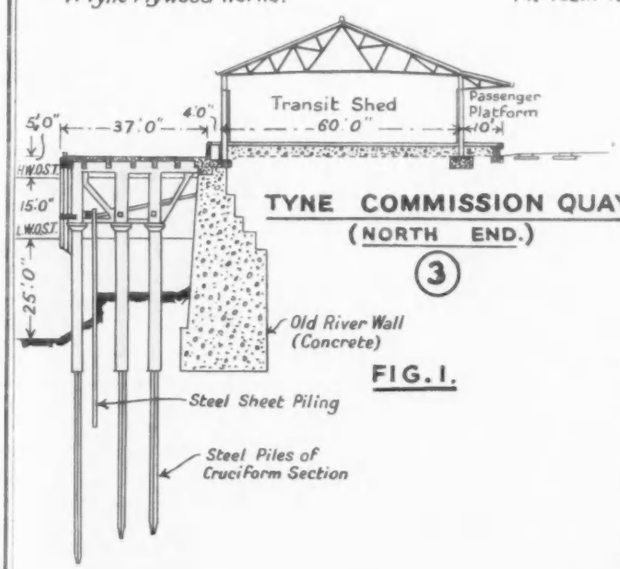
Scale for Plan.

FEET 1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10,000 FEET

NOTE;- Tyne Commissioners' Property edged Red.



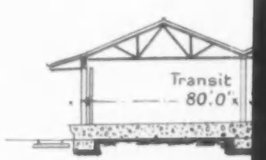
1. Construction of River Wall & Trimming of Bankside.
2. Riverside Development Scheme.
3. Tyne Commission Quay.
4. Tyne Dock.
5. Land Clearance.
6. Howdon Staith.
7. Tyne Plywood Works.
8. Land Clearance & Jarrow Staith.
9 & 10. Land Clearance.
11. Felling.
12. Newcastle Quay Extension.
13. Gateshead Clearance Scheme.
14. Team Valley Trading Estate.



TYNE COMMISSION QUAY. (NORTH END.)

3

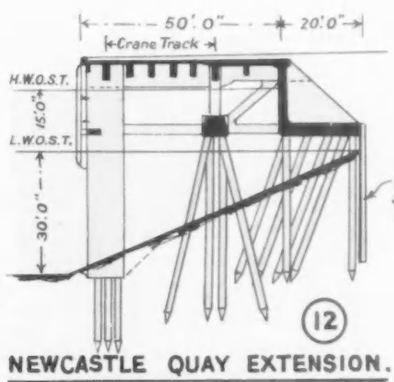
FIG. 1.



TYNE COMMISSION

3

FIG.



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NEWCASTLE QUAY EXTENSION.

FIG. 4.

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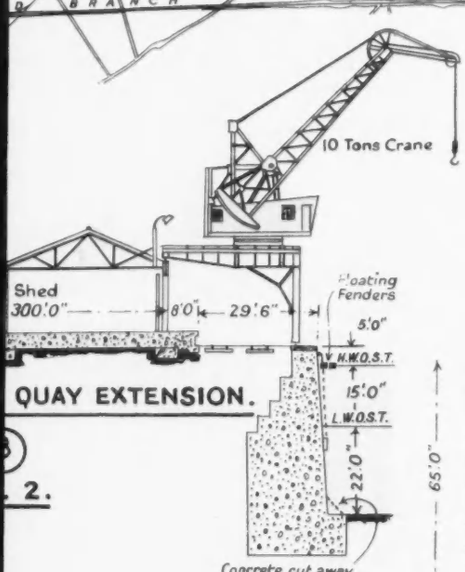
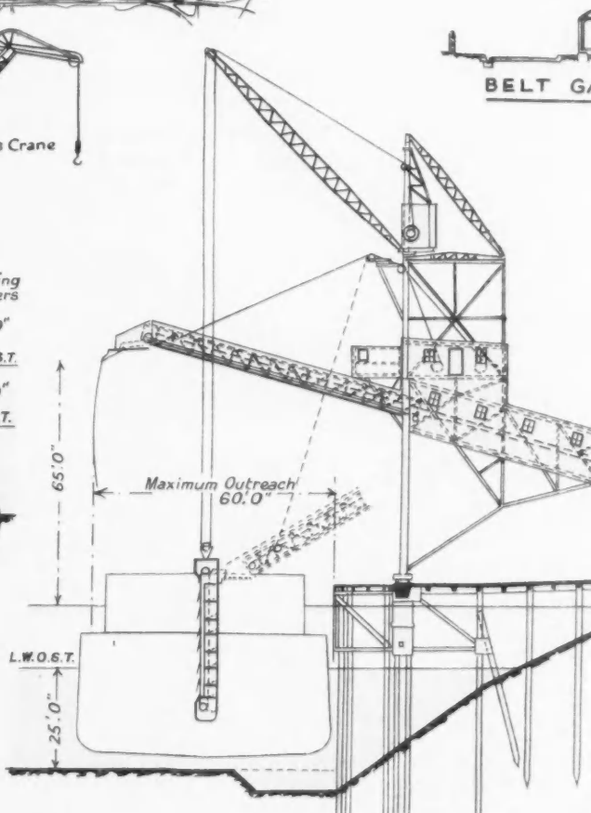
N—TYNE.

Q., M.INST.C.E.



QUAY EXTENSION.

2.

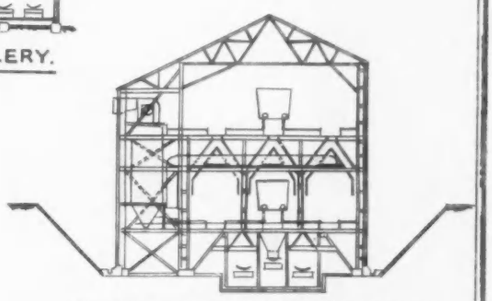


Scale for Sections.

20 30 40 50 60 70 80 90 100 FEET

KLOW, LITH., HARCOURT STREET, MARYLEBONE, W.

BELT GALLERY.



WAGON DISCHARGING HOUSE.

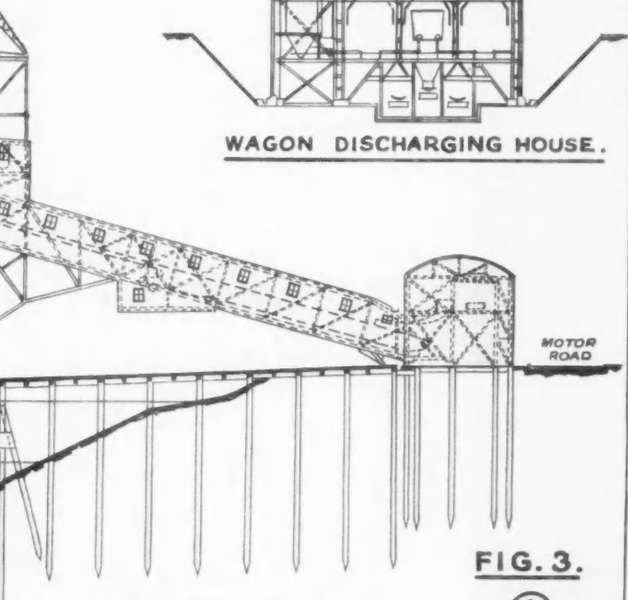


FIG. 3.

JARROW STAITH.
LOADING TOWER.

(8)

Some Modern Developments on Tyneside and at the Port of Newcastle-upon-Tyne

The Great Coaling and Industrial Centre of the North

By R. F. HINDMARSH, M.Inst.C.E., Engineer-in-Chief of the Tyne Improvement Commission

Introductory

THE conversion of the River Tyne from a shallow tortuous and dangerous stream, whence countless collier brigs no bigger than our modern barges sailed on their slow journey to London, into one of the safest of modern waterways and an important world-port is a romance of engineering. Newcastle was not, like many of our other ports, endowed by nature with the essentials of commercial greatness in an age of big ships, and what nature denied has had to be supplied by man.

It was in 1850 that Parliament, in spite of strenuous and influential opposition, constituted the Tyne Improvement Commission and gave it control of the destinies of the Port of Newcastle-upon-Tyne, thus opening one of the most romantic chapters in modern industrial history. At that time there was a bar across the mouth of the harbour, covered by only six feet of water at low water, the scene of many terrible wrecks in easterly gales and a constant cause of delay to vessels which had to stand off and on outside waiting for a tide to lift them over the numerous sand-banks and shallows. There is no bar now—it has been dredged away, and for nearly 30 years there has been a dredged depth of 30-ft. at low water where the bar was—sufficient, with the additional depth given by rise of tide, to float even the largest vessels and, thanks to the mile and a half of breakwaters which stretch out their huge arms into the sea and provide a safe haven for the thousands of vessels which every year pass between them, the entrance is easily made, even in bad weather, and the harbour is the principal harbour of refuge on the North-East Coast.

R. F. HINDMARSH, Esq., M.Inst.C.E.,
Engineer-in-Chief, Tyne Improvement Commission

In 1850 only barges could ply above the town of Newcastle. Extensive dredging and the substitution by the Commissioners of a swing bridge for an old fixed stone bridge made it possible to establish above the town a harbour almost as large as that at the entrance, with a dredged depth of 25-ft. of water at low water, where millions of tons of coal from the Durham coalfield are shipped annually.

In 1850 the Commissioners' revenue was £15,000. Since then it has increased to nearly £900,000 in one year, and the annual export of coal alone has reached the huge total of 21,500,000 tons, whilst there is a large and increasing volume of other exports.

Before 1850, the potential resources of the district were being only half-heartedly tapped. The neglect of the port that was its natural outlet was checking the growth of the ancient coal trade of Northumberland and Durham and riverside industries, but within a few years of the first sitting of the Commissioners, the "John Bowes," the first screw-driven collier, made its famous voyage to the Thames and back within a week, so sealing for ever the fate of the slow but picturesque "Geordie" brigs.

After this, the development of the port was rapid. Quays and staiths took the place of green fields and pleasant woods. Islands were removed and projecting points cut off. Shipyards, dry-docks, wet-docks, factories and arsenals destroyed the salmon-fishing, but created in its stead industries that employ a quarter of a million people and supply the world with ships, guns, steel, coal and many other products.

Even in 1872, an Admiralty Surveyor reported that "from "being a by-word of neglect and decay, the Tyne has been "converted into the most noteworthy example of river improve-"ment within the bounds of the United Kingdom."

Encouraged by the development of the port, existing industries have expanded and new industries have been established. The London and North Eastern Railway Company and the various riparian Corporations have all contributed to the provision of facilities for shipping. Newcastle Quay, the property of the City Corporation, is the recognised centre for the importation and distribution of provisions for a wide area. As a ship-repairing port, Newcastle stands unrivalled. As a ship-building centre, it is one of the largest in the world.

There are wet-docks, numerous quays, wharves and coal-shipping staiths up and down the river, all equipped with the necessary facilities for dealing with coal and general imports and exports. From end to end of the nineteen miles which the Commissioners control there is accommodation for shipping.

There are regular steamship services, not only to our own coastwise ports and to near continental ports, but to practically all quarters of the globe. The net register of sea-going tonnage which passes up and down the river in one year has reached the impressive total of 25,000,000 tons. In 1850, the year in which the Commission began to function, it was under 5,500,00 tons.

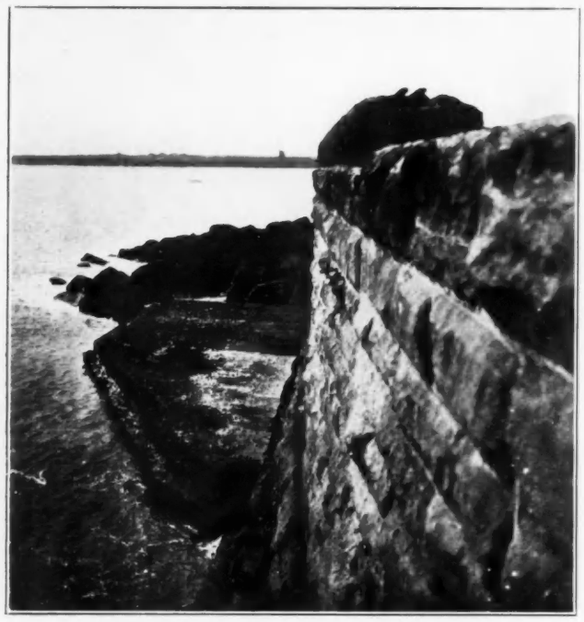
There have, of course, been many changes during the course of the industrial history of the river, industries have risen, flourished, and disappeared, many having left undesirable reminders of their previous existence.

The old collier brigs used to bring sand and gravel as ballast from the Thames on their return journeys, some of which was cast into the sea as they approached the port, some surreptitiously into the river under cover of darkness, and some piled in huge heaps on the banks of the river, the chemical industries piled their waste materials into huge heaps and the collieries, which adjoined the river in many cases, did likewise.

During the war, shipyards were extended and new shipyards opened in order to give increased output, some of these having since been closed and left derelict, and many derelict buildings

(1.) North Pier Apron at Low Water

Port of Newcastle—continued



(2.) South Pier Wavebreaker at Low Water

mark the sites of other industrial undertakings which have disappeared.

With the help of the Commissioner for the Special Area, and also through work undertaken by him, a great deal is now being done to clear up the unoccupied and untidy sites and to make them attractive for new industries, while the Team Valley Trading Estate is an outstanding example of a new area being laid out and developed for the same purpose and in order to provide employment, especially in the lighter industries.

A great deal is also being done by the Port and Riverside Authorities for maintaining, improving or extending the facilities of the port and providing better facilities for the industries and trade of the district.

The following is a description of some of the principal works either recently carried out or at present in hand for the furtherance of these objects:—

Tyne Piers

These breakwaters were commenced in 1854 and finished in 1895. In 1897-98 the North Pier was seriously damaged by the sea, and this involved the complete reconstruction of the outer portion of the North Pier in its present form—a work not completed until 1908.

Since 1908, in addition to the necessary maintenance work, the apron of 35-40 ton concrete blocks on the seaward side of the pier has been extended and strengthened.

A considerable number of square concrete blocks of 5-tons weight, in which copper slag has been used in the aggregate instead of gravel, have been made and placed on the rubble mound and along the edge of the apron blocks.

Photograph No. 1 shows the apron at low water.

More recently, a spearhead consisting of solid block work all cramped together and to the pier itself, was constructed at the east end of the pell mell wave-breaker to take the first shock of the waves, and has admirably fulfilled its purpose to the present time. Photograph No. 2 shows this work at low water.

South Shields Corporation Riverside Development Scheme

This scheme, which is being carried out by the Corporation of South Shields under the direction of their Engineer, Mr. John Reid, Assoc.M.Inst.C.E., entails the reclamation of 12 acres of land and clearing about 3,000-ft. of river frontage, also the construction of a new 45-ft. motor road from the Market Place to the harbour mouth, crossing the L.N.E.R. Co.'s lines on a reinforced concrete bow string girder bridge. The road and necessary retaining walls between the harbour mouth and Mile End Road are now complete.

Many old derelict buildings are being demolished and the land cleared and levelled, where necessary, in the neighbourhood of this road to suit it for future development.

Rail access to the river side is provided by a single track railway which joins the L.N.E.R. Co.'s line near South Shields Station. Sidings are being provided behind the line of the proposed quay.

River-front sites are connected to the new road by a 20-ft. service road.

Owing to the unevenness of the old quays, etc., steel sheet piling has been driven on a line sufficiently far from the Tyne Improvement Commissioners' deep-water quay line to permit of the construction of a reinforced concrete quay with a depth of water alongside of 30-ft. below L.W.O.S.T., should this at any time be required. The estimated cost of the work in hand is £196,000, and a grant of £121,000 has been made through the Commissioner for the Special Area towards the cost.

Construction of River Training Wall and Trimming of Banksides at Tynemouth

This work is being carried out by the Tynemouth Corporation under the superintendence of the Borough Surveyor, Mr. D. M. O'Herlihy, B.Sc. (Eng.), Assoc.M.Inst.C.E.

Erosion has been taking place for a great many years to the boulder clay cliffs on the north bank of the River Tyne.

These cliffs rise in broken formation at a slope from beach level varying from 1 in 1¼ to 1 in 2½ to a height of 100-ft. above beach level.

In 1936, the Corporation sold five acres of land to the Sir James Knott Memorial Trust, adjoining the top of the cliffs, for the erection of a block of 135 flats, in which it proposed to re-house displaced tenants from the clearance areas situated in the east end of the town, having particular regard to seafaring families.

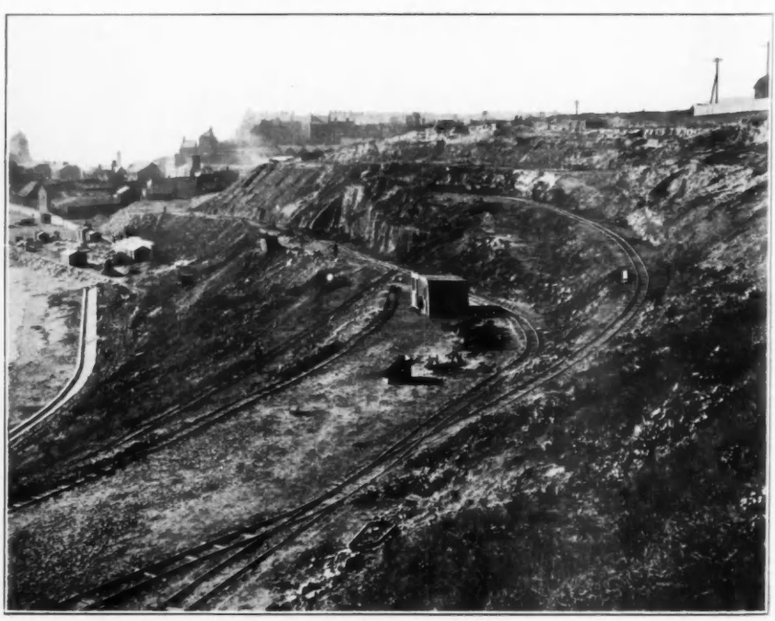
At the same time the Corporation undertook to protect the base of the cliffs by constructing a river training wall over a length of 423 yds., and to execute preliminary work for a projected parkway extending ultimately from the Fish Quay at North Shields to Tynemouth, at a total cost of £30,000.

This work, which is at the point of completion, has involved the excavation and filling of 80,000 cu. yds. of material to form the 50-ft. wide parkway, which rises at a gradient of 1 in 26 from the base to the top of the cliffs.

Various strata have been encountered in the work, varying from thick beds of sand to exceptionally hard boulder clay, which necessitated pneumatic spades being used in the excavation. The way in which this clay face stands, almost vertically, is shown on photograph No. 3.

Considerable difficulty has been experienced with the easterly portion of the wall over a length of 73 yds., which after completion showed signs of movement. Where the wall was founded on the boulder clay this movement was in the nature of a sliding movement, but where the foundations were carried into the shale the movement was of an overturning nature.

Counterforts will later be constructed to resist the movement.



(3.) Construction of River Wall and Trimming of Bankside at Tynemouth

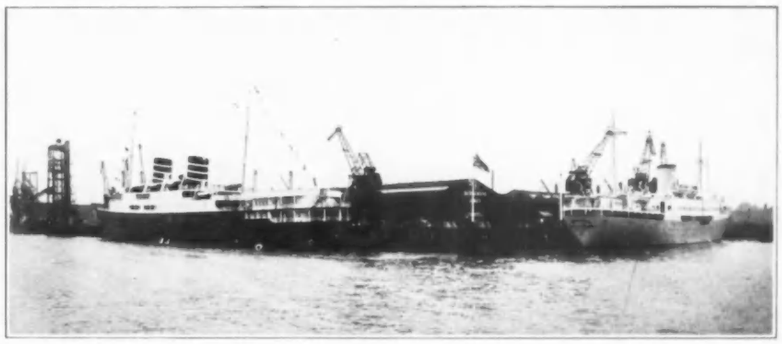
Port of Newcastle—continued

Tyne Commission Quay

The quay, opened in 1928, is 1,100-ft. long, is situated about two miles from the River Tyne entrance, and forms the riverward side of the Albert Edward Dock.

The river frontage formerly consisted of a concrete quay wall with a maximum depth obtainable alongside of about 14-ft. at low water ordinary spring tides. The old wall is immediately behind the new quay.

The first step in the construction of the new quay was to drive steel sheet piling along nearly the whole length of the old quay, and to tie back at frequent intervals the sheet piling to anchor blocks placed under the passenger platform of the transit shed. Dredging was then carried out to 25-ft. at low water ordinary spring tides along the whole length of the quay. Thereafter, the construction of the quay was proceeded with. Provision has been made for an ultimate depth of 30-ft. at low water ordinary spring tides.



(4.) Tyne Commission Quay with M.S. Vega alongside

The bed of the river on which the new quay is constructed is of a varied nature, consisting at the south end of sandstone and at the north end of soft mud. The varying strata called for different methods of construction. Three distinct varieties were adopted, the south end of the quay being built on cylinders varying from 6-ft. to 13-ft. in diameter, sunk under compressed air, founded on rock and filled with concrete. Northward of the cylinders the quay is carried on ferro-concrete piles, and still further northward, where soft sand extends to a depth of about 80-ft. below low water ordinary spring tides, steel cruciform piles up to 90-ft. in length have been driven down to rock and encased in steel tubes filled with concrete. The superstructure of the quay throughout is of ferro-concrete, except at the north-east end where timber has been used for fendering purposes.

A single-storey transit shed, 650-ft. long and 60-ft. wide, is situated about 41-ft. from the quay face, and contains Passenger and Customs Offices, and a railway platform so that passengers may be conveyed by train between the quay and any part of the railway systems in the country. For this purpose the railway lines were re-laid and extended, and a new system of signalling installed in order to meet requirements of the Ministry of Transport and the London and North Eastern Railway Co. On the quay front are laid two lines of railway and crane track, on which four electric cranes (one $1\frac{1}{2}$-ton, two 3-ton and one 5-ton) have been placed.

A hydraulic lift, capable of lifting loaded 20-ton coal-wagons and delivering into ships at a height of 65-ft. above high water ordinary spring tides, at speed of 500 tons per hour, has been erected.

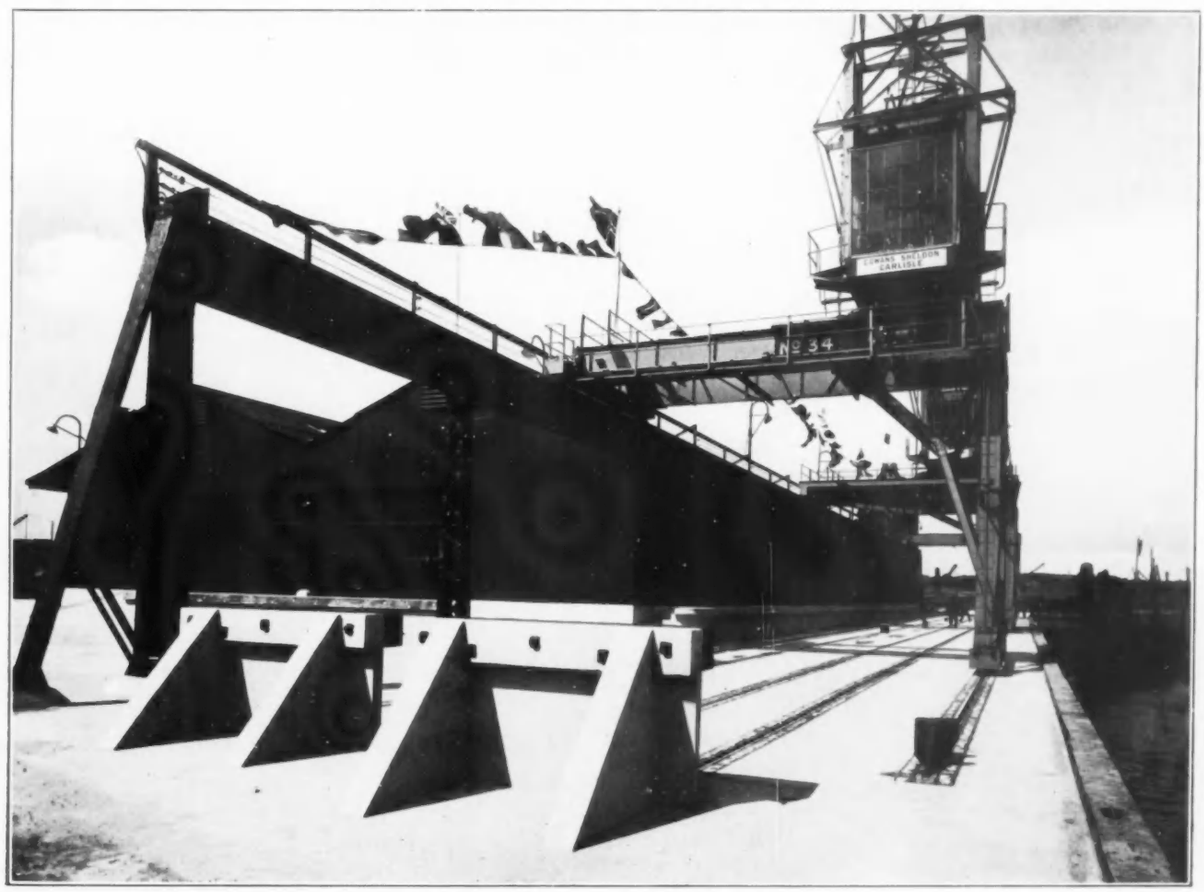
Photograph No. 4 shows the quay and the new Bergen Mail steamer "Vega" alongside, and Fig. 1 in the Illustrated Supplement shows a cross-section of the quay.

Tyne Commission Quay Extension

This quay was constructed in 1937, principally for the Tyne to Oslo trade. Excellent service by water, rail and road is available, including passenger rail service to and from the adjoining station, i.e., at Tyne Commission Quay. The berth is about 450-ft. long, and is immediately in line with the lock of the Commissioners' Albert Edward Dock.

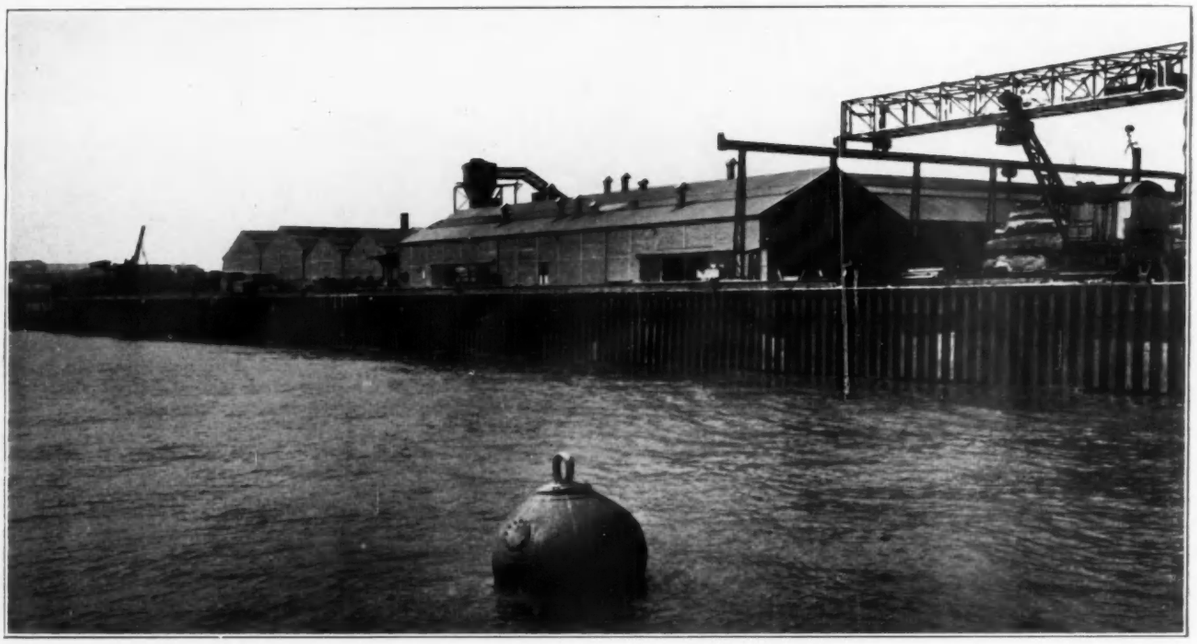
Clearance work involved the demolition and removal of the Customs House and old Hydraulic Engine House, and the removal and re-erection on piled foundations of a hydraulic accumulator.

The water space between the existing quay and the dock entrance wall has been decked over with ferro-concrete decking carried on 24-in. hollow octagonal concrete piles 90-ft. in length, this length being required to reach a sound foundation. A



(5.) Tyne Commission Quay Extension

Port of Newcastle—continued



(6.) Steel Sheet Pile Quay at the Tyne Plywood Works

single-storey steel transit shed, about 300-ft. long and 80-ft. wide, has been constructed 37-ft. behind the quay edge, allowing for a loading platform, two lines of railway and crane-track between the shed and face of quay. The shed has sliding doors for easy access, and has ample roof-lighting. Arrangements have been made for the Customs' inspection of passengers, luggage, etc., adjacent to the passenger entrance at the centre of the shed.

A new concrete road and concrete paving completely surrounding the shed have been formed, all railways being laid flush with the surface for the convenient working of motor traffic.

Three electric semi-portal travelling cranes, two of 1½-tons and one of 10-tons capacity, have been provided for cargo handling, new cables having been laid from the Commissioners' Power Station, both for power and lighting.

The quay has been well fendered and equipped with electric capstans, water mains, etc., including arrangements for fresh-water service to ships using the berth and new Customs and Shipping Offices. Six lock-up garages for passengers' cars have been erected in close proximity.

To enable the work to be completed in the seven months available, special methods, such as handling the unwieldy concrete piles by means of the " Titan " floating crane and the pre-erection of the electric cranes on an adjacent site preparatory to lifting them completed on to their new track, were called for.

Photograph No. 5 shows the quay. Fig. 2 in the Supplement is a cross section of the quay.

Tyne Dock

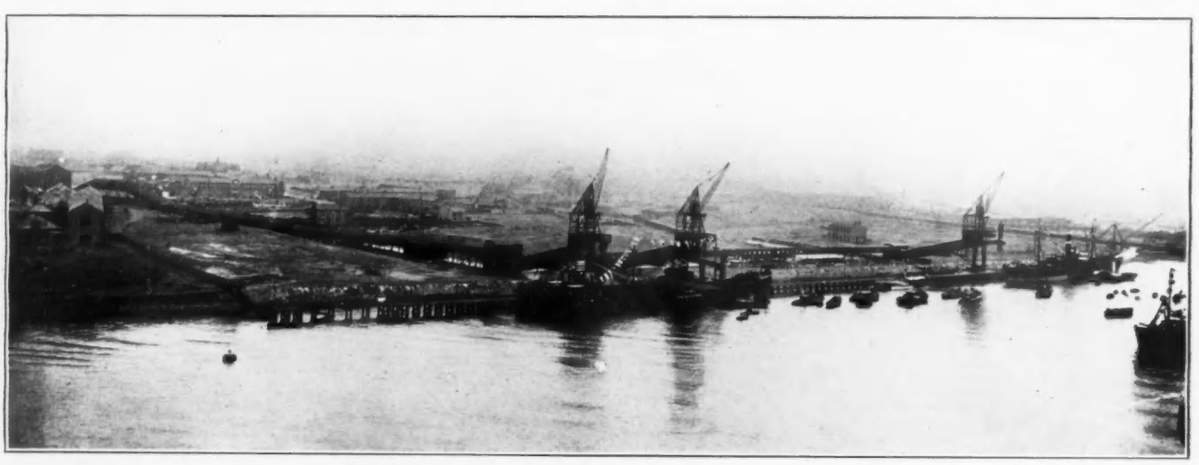
Last year the Tyne Commission purchased this dock from the London and North Eastern Railway, and since acquisition, have been busy in re-conditioning and improving the existing dock equipment and clearing away unnecessary old structures. New traffic offices are being built, the public street near the main entrance widened and improved, new locomotives are on order, additional wagons have been purchased, the maintenance workshops are being modernised and re-equipped, the old buoy moorings have been removed and new moorings laid down, and plans are being prepared for a new 800-ft. quay inside the dock and a new 1,400-ft. riverside quay outside the dock. Both quays are to be equipped with up-to-date cargo handling appliances.

The riverside quay will have a depth alongside of 35-ft. at L.W.O.S.T., and the channel of the river from the sea to the quay, a distance of three miles, is to be deepened to the same depth.

Clearance Schemes

Eltringham's shipyard, one of the first sites to be dealt with, was, during 1936-37, cleared and levelled, and a steel sheet pile quay 650-ft. long with a depth of 12-ft. at L.W.O.S.T. alongside constructed by the Commissioners. This site is now occupied by the Tyne Plywood Works, Ltd., who have built a factory for the manufacture of plywood, a new industry to Tyneside and the first of its kind introduced into this country. Photograph No. 6 shows the quay and factory.

The Renwick & Dalgliesh shipyard at Hebburn, together with the pit refuse heaps behind, has been cleared and levelled. The east side of this site is now partly occupied by Jarrow Staith.



(7.) Site Cleared by the Tyne Commission and Jarrow Staith

Port of Newcastle—continued

The adjoining site to the west, which was the Hebburn U.D.C. refuse tip, is to be cleared and levelled and a timber quay constructed along the whole of the river frontage. The quay will have a depth of water alongside of 30-ft. below L.W.O.S.T., and will be served by road and rail connections. The site is likely to be further developed in the near future. Photograph No. 7 shows the site and Jarrow Staith.

A site with 1,500-ft. of river frontage at the north-west corner of Jarrow Slake, covering an area of about 12 acres, is also to be cleared and tidied up. Part of this site was formerly used as a cement works, and is at present covered with derelict buildings, tanks, walls, etc., and hills of ballast. Apart from demolition, about 85,600 cu. yds. of material will have to be shifted. Photograph No. 8 shows part of this site.

(8.) Derelict Structures at Jarrow to be cleared by the Tyne Commission

Another site of an old chemical works further up the river at Hebburn is to be dealt with. This site covers an area of about 28 acres with a good river frontage. On this site there are about 130,000 cu. yds. of material to be handled.

The tidying and clearing up of the site of an old lead works at St. Anthony's is nearing completion. This site was covered with the derelict remains of buildings, walls, tanks, engine beds, and flues of all sizes. These are all being demolished and the debris removed, and a chimney about 160-ft. high, which is near the L.N.E.R. Co.'s riverside line, is being taken down from the top. The existing quays are being repaired and built up and a new river wall constructed. The site covers an area of about six acres, and has excellent facilities for road, rail and water connections.

The work on the sites at Hebburn, Jarrow and St. Anthony's has been undertaken by the Tyne Commission with grants from the Commissioner for the Special Area, who is also, through the North Eastern Trading Estates, Ltd., with Sir Alexander Gibb & Partners as Consulting Engineers, carrying out a scheme, covering a large area, which extends roughly for the greater portion of the water front of the Borough of Gateshead between Redheugh Bridge on the west and the borough boundary on the east. Much of the land is at present covered with the remains of demolished or partly demolished buildings, and, though potentially valuable, is unattractive for development in its present condition. The scheme provides for the clearance and, where necessary, the levelling of the areas concerned, the construction of estate roadways and other works, with the object of providing eligible sites for industrial development together with areas for housing purposes and open spaces.

Felling Point Removal

This scheme, which is being undertaken by the Tyne Commission with a grant of 25 per cent. from the Commissioner for the Special Area towards the cost of the work, involves the removal of an old coal staith and a rocky point which projected into the river and constricted the channel. About 36,000 tons of hard sandstone have to be removed by submarine blasting and dredging, and about 47,000 tons of soft material by dredging. The result of the work when completed will be an increase in width of the deep-water channel by a maximum amount of 52-ft. over a length of 1,100-ft., a clearer view around the bend for vessels and less difficulty in navigation by virtue of the improved stream conditions.

Howdon Staith

In 1931, in agreement with the Hartley Main Collieries, the Tyne Commission decided to construct an up-to-date coal shipping plant. This consists of two loading berths, 450-ft. apart, with provision for a future third loader to travel between and serve either berth. Berthing dolphins were constructed equally spaced between the two berths with end dolphins 160-ft. and 110-ft. beyond the east and west berths respectively, and all were connected up by a continuous gangway, 742-ft. long, with approach gangways from the shore at each loader. The berths were dredged to a depth of 25-ft. below L.W.O.S.T. A waiting berth, consisting of three island dolphins, was also constructed immediately east of the main structure.

As the berth was constructed in front of an earth embankment with stone pitched slopes and puddle clay core, being the south wall of Northumberland Dock, it was projected 135-ft.

(9.) Aerial View of Howdon Staith

Port of Newcastle—continued

into the river and the wall protected by steel sheet piling over the full length of 742-ft.

The coaling towers, each with a normal travelling load of 200 tons, were carried on cylinders founded at about 72-ft. below L.W.O.S.T. in shale. The number of cylinders was limited by placing them immediately beneath the radial track of each loader, heavy bracing being incorporated in the approach gangway, to maintain the correct radius.

The main dolphins carrying the loaders were carried out in reinforced concrete and the berthing dolphins and gangways in timber.

An 18-ft. concrete motor road was constructed to provide easy access to the berth and the verges were planted with grass and shrubs with pleasing effect.

The two towers, each capable of shipping over 500 tons of coal per hour, are situated 450-ft. apart, each having a radial travel of 90-ft. and a maximum delivery height of 61-ft. above H.W.O.S.T. with an outreach of 55-ft. beyond the face of the quay or immediately alongside to load into small craft.

Coal is carried along belt conveyors from the teeming hoppers to the towers for a distance of 800-ft. to the west tower and 1,250-ft. to the east tower. The discharge of any class of coal from the hoppers is regulated through adjustable doors on to jigging feeders, which pass a regular stream on to the belts which run at a minimum speed of 350-ft. per minute.

From the extreme end of the loading arms the coal is delivered either by rotary spouts into any part of the ship's hold or, where breakage is a consideration, the stream is delivered through an anti-breaker of the " Handcock " pattern, suspended from a 12-ton jib crane erected on the towers, and is thus controlled practically to the floor of the hold.

Photograph No. 9 is a view of Howdon Staith.

(To be continued).

Port Labour Problems

The Organisation of Port Labour at Rotterdam

By Ir. A. PLATE, President of the Scheepvaart Vereeniging Zuid (Shipping Federation South) at Rotterdam

Problem of Irregularity of Work.

Before the port labour was organised, the situation at Rotterdam was such that anyone possessing a certain physical fitness, enabling him to perform dock labourers' work, was in a position to compete for the available work. Every employer had a nucleus of more or less trained regular labourers, or otherwise casual labourers who worked regularly for him and enjoyed a certain preference. These nuclei had to be supplemented by large groups of unskilled casual labourers.

The standard wage for this unskilled labour was fairly high.

The attraction exercised by the port on would-be dockers was further stimulated by the temporarily heavy demand for labour sometimes occurring as a consequence of the greatly fluctuating opportunity for employment to which the seaport industry is subject.

Ir. A. PLATE,
President of the Shipping Federation South at Rotterdam

In addition to the factors of an economic nature, the weather conditions (gales, fog) also contribute in no small measure to the irregularity of the demand for labour. The upshot of this was that the unemployed in other industries attempted not only too eagerly to secure a share of the available port work.

The preference given by the dock labourers to some definite kind of work, caused a superabundant flow of labour to the places where labourers were engaged for this work, whereas, at places where less popular work was offered there was a shortage of labour, which could frequently be provided for only after great delay.

As a certain routine and experience is also required for unskilled work in order to obtain a reasonable output of work, it certainly stands to reason that this, with an extremely floating working population, owing to the above-mentioned circumstances, was not so favourable as might be deemed possible.

The constant exchange of large groups of labourers among individual employers had a destructive influence on the labour discipline. A labourer who was discharged the one day by an employer for bad conduct, offered himself with success the following day to another employer. Greatly to the disadvantage of the bona fide labourers, this lack of control was the magnet that attracted extremely unfavourable elements to the port. It was especially these elements that were responsible for theft and pilferage, the evil occurring in most ports.

Notwithstanding the relatively high standard wage, large groups of dock labourers were unable to earn a reasonable weekly wage, owing to the excess of applicants among whom the work had to be distributed.

The waiting—frequently in vain—for work in public houses in the vicinity of the places where hands were engaged for the work, resulted in a large part of the wages being spent before being earned.

That, under the circumstances outlined above, the socio-economic position of many dock labourers was anything but satisfactory, may easily be imagined, and it is therefore no wonder that this led to disturbances in the regular course of this industry.

The strikes of that time, of a local or general character, which occurred repeatedly, causing interruptions of the work of a longer or shorter duration, were a result of this. In the interests of employers and employees, it became necessary to put an end to these unsatisfactory conditions, the detrimental consequences of which had, in a large measure, to be borne by the shipowners whose vessels called at the port.

Already for a long time it had been evident to employers that it would only be possible to solve the problem by co-operation on the part of all parties interested. This co-operation has at length been achieved, and it is owing to the services rendered by the Federation of employers in the port and transport trades at Rotterdam, called the Shipping Federation South (S.V.Z.=Scheepvaart Vereeniging Zuid), that the problem has been successfully solved.

The S.V.Z., in which, according to the nature of their industries, the various employers in the port industry are associated in the following groups: shipbrokers, stevedores, forwarding agents and related industries, grain elevator companies and transhippers of grain, warehouse companies, mechanical handling of bulk cargoes, and Rhine navigation companies, forms the representative employers' organisation in the port industry, and it is recognised as such by the Authorities. Owing to this position, it stands to reason that the S.V.Z. was the proper body to make regulations for the organisation of the port labour, to put them into execution and to consolidate them.

Registration of Dock Labourers

One of the first conditions for attaining improvement in the unsatisfactory situation was the checking of the uncurbed flow to the port of unemployed from other industries and agriculture. For this purpose it was necessary to register those casual dock labourers who came into consideration, and in proof of this registration, to hand to them registration certificates, on production of which they might compete for work.

At the same time, the registry offices and the hours at which men were engaged were centralised, for which purpose the Dock Labourers' Reserve (H.A.R.=Haven Arbeids Reserve) was founded by the S.V.Z. This institution was charged with the registration of the dock labourers, it acts as medium between employer and employee and carries out the administration connected therewith.

On either side of the River Maas an office for the engagement of dock labourers was established at points in the port territory, suitable for that purpose.

The H.A.R. (Dock Labourers' Reserve) was to serve as a reservoir to which those labourers who had become unemployed could flow and from which labourers could be obtained for the new work that presented itself. The employers undertook to engage casual labourers exclusively from the H.A.R. at the hours fixed for this purpose. On the other hand, the labourers had the obligation of presenting themselves for work at these hours at the offices of the H.A.R. where they were registered.

The certificate of registration, numbered and made out in the name of the registered labourer, contains the regulations of the H.A.R.; it is arranged in such a way that the shifts worked, i.e., half-day's work, can be notified in it and stamped with the date.

In addition to the casual labourers, the dock labourers in regular service with the employers associated with the S.V.Z. are also registered with the H.A.R.; as a consequence of this the H.A.R. has at its disposal the administrative data required for the carrying out of the social insurance.

Port Labour Problems—continued

Engagement and Setting to Work of Casual Labourers

The working day, in virtue of the wage and working conditions ruling, is divided into five shifts of 4 and 4½ hours alternately.

The labourers present themselves three times a day for engagement in the waiting room, specially installed for this purpose, of the office where they are registered. The employers' foremen make their selection from the labourers present and collect the certificates of registration from the labourers engaged, which are stamped with the name of the employer by the staff of the H.A.R. as a sign that they are engaged for work.

The employer has the right to continue the engagement of the casual labourer already engaged, so that it may occur that labourers work for the same employer some weeks in succession.

After the labourer has performed his work, his book is stamped by the staff of the employer. If a labourer is not re-engaged by his employer, he then again presents himself at the next hour for engagement at the office of the H.A.R., where he is registered.

The registration certificates of the labourers who are not engaged for work are provided with an unemployment stamp, which is accepted by the Authorities as a proof of involuntary unemployment with respect to the granting and calculation of the dole.

Centralisation of Payment of Wages

The centralisation of the engagement of labourers has led, more than has been the case hitherto, to great numbers of casual labourers being employed by three, four and more employers in one working week, which, for these labourers, formed an inconvenience when collecting their wages.

In order to avoid the disturbing influence of this on the regular course of engagement, the payment of wages was centralised with the H.A.R.

On Friday, or Saturday, an advance is given on the shifts worked which are stamped on the certificate of registration by the employer, to the amount of the normal wages due for those shifts.

In the week following the employers furnish the statements of the wages actually earned to the H.A.R., so that the balance may be fixed and settled on the pay-day of that week.

If it appears that the statement of the employer differs from that of the man, an investigation is made as to where the difference is, and, after consulting the employer concerned, the definite settlement takes place in the week following. In this manner errors, misconceptions concerning the application of the wage conditions, on the part of the labourers as well as on that of the employers, are cleared up without friction; moreover, losses for employers through stating too high an amount for the wages may thus be obviated.

The data obtained from the statements of wages given by the employer concerning the shifts worked and the wages earned are used for the compilation of work and wages statistics.

Collective Labour Agreement (C.A.O.)

The wages and working conditions, on the basis of which work is performed in the port industries, are usually regulated between the S.V.Z. and the labourers' organisations by the C.A.O. (Collectieve Arbeids Overeenkomst = Collective Labour Agreement.)

As a rule, disputes concerning the application of the stipulations of the C.A.O. are settled amicably by consultation between the boards of the S.V.Z. and the labourers' organisations concerned.

Disputes which cannot be settled in this manner may be submitted to the award of a Permanent Arbitration Board instituted by the C.A.O. In this Arbitration Board both parties are equally represented; its award is binding in the last resort.

The wage and working conditions fixed by the C.A.O. regulate: the arrangement of the working hours (see the distribution of shifts given above), the duration of the work (8½ hours a day and 48 hours a week), the rest intervals, overtime (maximum 2 hours a day, but on the understanding that a 10 hours' working day may not be exceeded), and the work on Saturday afternoons.

Overtime is permitted only in certain circumscribed cases; this also applies to work on Saturday afternoons; for work on Sunday permission is required from the Authorities.

Further, the wage and working conditions regulate the minimum wages of regular labourers and the standard payment per shift of the casual labourers, as well as the rate for piece-work and remunerations for special kinds of work.

Regular labourers have, in virtue of the present C.A.O., a right to two to six days holiday per year, dependent on the duration of the employment, while the casual labourers are entitled to one to four days per year, according to the number of shifts worked by them.

Labour Control

Although the wage and working conditions are efficiently regulated, there is always a possibility of an incorrect application or interpretation of them leading to the outbreak of labour disputes at the spot where the work is performed, which might have a prejudicial influence on the quick despatch of the seagoing vessel concerned.

In order to avoid the occurrence of such conflicts, the S.V.Z. has some inspectors in its service, who regularly visit the places where port labour is performed, and whose task it is to act as mediators in the event of difficulties occurring with respect to the application of the wage and working conditions, and who, if requested, can give advice to the foremen.

This regular control has proved to be of special value in the case of small, isolated, conflicts, which, as there is always a risk of their spreading, are of sufficient significance to be restricted to the utmost. Moreover, through these inspectors the executive of the S.V.Z. keeps in daily contact with the practice of the industry and thereby keeps in close touch with what is going on in the port, which, in connection with the determination of its activities and the giving of guidance, is indispensable.

Police Control

Besides the measures taken by the Government and Municipal police in the docks at Rotterdam to check the evil of pilferage and theft, an evil occurring in most ports, a regular police supervision is held by the S.V.Z.'s own police corps. This corps consists of selected men, who have had a police training; they have the same powers as the members of the official police.

The activity of this corps also has a strongly preventive effect, as a consequence of which the theft and destruction of goods belonging to the ship or the cargo are restricted to the utmost minimum.

As the need was felt of an extra watching and supervision of a more constant nature in the handling of valuable goods in holds, sheds, warehouses, on gangways and quays, the corps was increased by the addition of a number of assistant inspectors, who are placed at the disposal of members of the S.V.Z. against payment at a fixed rate. This special supervision is very satisfactory, so that a regular use is made of the services of these inspectors.

Psycho-technical Examination

The rationalised methods of working and the machines that are gradually becoming more and more complicated, now in use for the port labour, naturally make higher demands on the psychical qualities of various groups of labourers than was formerly the case. For these reasons, and for the sake of the productivity of the work, and especially with a view to the problem of the prevention of accidents, selection is of the greatest importance.

Therefore, in order to give more weight to the personal judgment of the managers who have to make this selection, the results of psycho-technical science are utilised which reflect the characteristics of the persons concerned in a measureable form.

Moreover, the augmentation of the demands made on the labourers concerned, has been attended by a considerable lengthening of the time of their training, which has consequently become more expensive. For this reason, it is a matter of financial importance to avoid the training of labourers who, later on, might prove to be unsuitable for the work required of them.

One thing and another has given the S.V.Z. reason for extending its organisation with a psycho-technical laboratory, where labourers may be tested psycho-technically by an expert, at a fixed rate of remuneration payable by the employer concerned.

Effecting of Social Insurances

In the effecting of these insurances the S.V.Z. takes a very active share, for which it has availed itself of the organisation of the H.A.R.

For the medical control of sick men and those who have met with an accident, the S.V.Z. has a medical staff, which, at the same time, gives medical treatment in cases of accidents to labourers; for this latter purpose, the S.V.Z. has the necessary bandaging rooms in the dock territory at its disposal. These insurances are prescribed by law.

Employers and employees are equally represented on the Board of the sick fund insurance.

The system applied to these insurances renders it possible not only to limit the cost to a minimum, but at the same time to take care that the insurance interests of the dock labourers in question are well looked after.

Results

If it be asked whether the organisation of the port labour has come up to expectation, the answer can undoubtedly be given in the affirmative.

By means of this organisation the characteristic feature of port labour, viz., the casualness with regard to the chance of work, is largely eliminated. As a consequence, the average weekly income of the casual labourers has not only been raised, but it has, at the same time, obtained a more constant basis than was formerly the case.

(concluded on page 331)

Southampton Docks Extension*

By MALCOLM GORDON JOHN McHAFFIE, M.Inst.C.E.

(concluded from page 293)

Greenheart Tests

The timber used for the meeting-faces on the caisson was greenheart. As no information appeared to be available regarding the mechanical strength of this timber in structural sizes, it was considered desirable that tests should be made to ascertain the behaviour of the timber under heavy load, and to establish a working stress on which the design could be based.

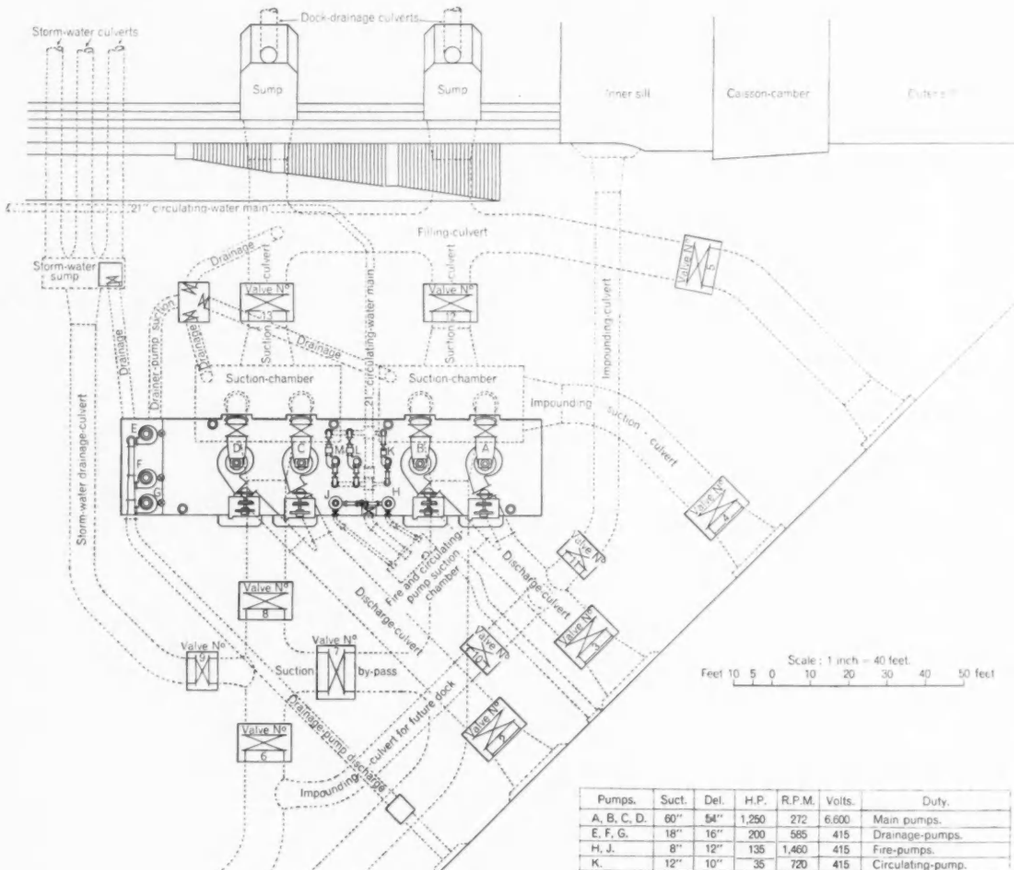
Four pieces of uniform character and comparatively free from defects were selected for test and were prepared to the following dimensions: two 20-in. long by 10-in. by 10-in., and two 20-in. long by 14-in. by 14-in. The tests were carried out in a 500-ton hydraulic machine at the Building Research Station, Watford.

The results were as follows:—

Piece No.	Size	Compression-stress at limit of proportionality of stress to strain:		Compression-stress at maximum load:	
		lb. per square inch	tons per square foot	lb. per square inch	tons per square foot
1	10 inch by 10 inch	1,030	66	2,420	156
2	,, ,,	1,010	65	2,510	162
3	14 inch by 14 inch	1,440	93	2,300	148
4	,, ,,	880	57	1,960	126

The 10-in. by 10-in. pieces were practically free from defect, and were probably rather above the average in quality; they gave consistent results, both at the limit of proportionality and at the maximum load when failure occurred. The 14-in. by 14-in. pieces, although comparatively sound, were slightly defective. They did not give such consistent results as the 10-in. by 10-in. pieces, and the fact that the compressive stress at the limit of proportionality in the case of piece No. 3 was approximately 50 per cent. above the remainder was considered to be abnormal.

FIG. 17.



Pumps.	Suct.	Del.	H.P.	R.P.M.	Volts.	Duty.
A, B, C, D.	60"	54"	1,250	272	6,600	Main pumps.
E, F, G.	18"	16"	200	585	415	Drainage-pumps.
H, J.	8"	12"	135	1,460	415	Fire-pumps.
K.	12"	10"	35	720	415	Circulating-pump.
L, M.	16"	16"	32	480	415	Circulating-pumps.
House	5"	4"	23	1,420	415	House-drainer pumps.
Valve-pit	2½"	2"	3	1,420	415	Valve-pit drainer pumps.

PUMP-FLOOR AND CULVERTS ON WEST SIDE OF GRAVING DOCK.

Having regard to the fact that the timber would be firmly fixed between steel angles on the caisson, and lateral expansion under load would thus be restrained, and that longitudinal expansion would be resisted in timber in long lengths, it was considered that figures in excess of those obtained in the test could reasonably be expected under working conditions, and a safe working stress of 40 tons per sq. ft. was adopted.

Culverts and Pumping-Station Equipment

As previously stated, a site has been reserved on the west side of the present dock for another dock to be built in the future, and the pumping plant has been designed so as to be capable of dealing with both. This requirement resulted in the necessarily complicated system of culverts shown in Fig. 17. In designing the lay-out of the culverts the following operations had to be provided for: emptying, draining, filling, impounding and pumping storm-water, with the possibility of three of these operations being necessary at the same time when the second graving dock is built.

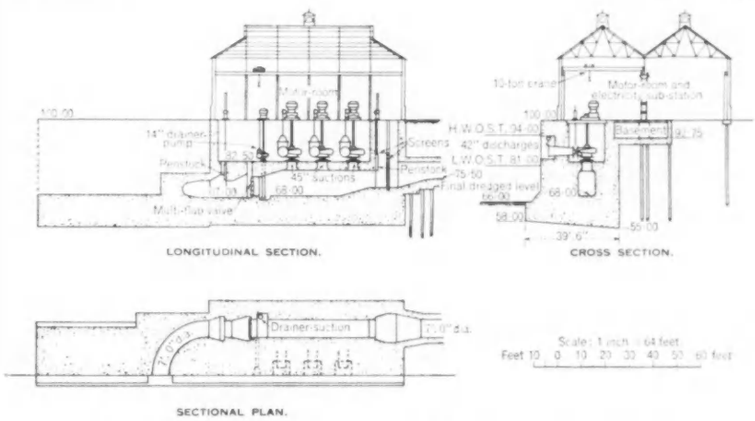
Two filling-culverts, each 10-ft. in diameter, are provided, one on each side of the entrance. On the east side the culvert is led into the back end of the caisson-camber, the water flowing through the camber to another culvert 10-ft. in diameter situated near the open end, and thence into two 6-ft. 6-in.

*Paper read before the Institution of Civil Engineers on 26th April, 1938.—Reproduced by permission of the Council of the Institution.

Southampton Docks Extension—continued

diameter culverts communicating with a pair of sumps on the east side of the dock floor. By this means a flow of water is induced along the length of the camber which helps to keep it clear from silt; furthermore, by keeping valve No. 22 open, resistance to movement is lessened when the caisson is being drawn back into the camber. The filling culvert on the west side connects with the two 10-ft. diameter suction-inlets on the dock side of the suction valves, the water entering the dock through a pair of sumps similar to those on the east side. The water entering the dock from the sumps is deflected upwards at floor-level, so as not to impinge on the keel-blocks and thus tend to carry them away. The four sumps in the dock floor are connected across the dock by 4-ft. diameter culverts, so that they also function as drainage-sumps when the dock is being pumped out.

The main pumping equipment consists of four centrifugal vertical-spindle double-inlet pumps, having 54-in. diameter delivery and 60-in. diameter suction branches; each pump is driven by a 1,250-b.h.p. synchronous induction motor operating on a 6,600-volt 3-phase 50-cycle supply. The dock, when full at H.W.O.S.T. and having no ship therein, holds 260,000 tons of water, and the main pumps are capable of dewatering it in four hours.



Figs. 18. Storm-Water Pumping Station and Electricity Sub-Station

For floor drainage three centrifugal vertical spindle single-inlet drainer pumps, having 16-in. delivery and 18-in. suction branches, each driven by a 200-b.h.p. motor, are provided.

For the supply of sea-water to the auxiliary condensers whilst certain ships are still afloat in the dock, a 10-in. centrifugal vertical-spindle pump, driven by a 35-b.h.p. motor, is provided. For the supply of condensing water to the ship after the dock is pumped out, a 21-in. diameter main is provided, from which a connection can be made to the ship below the water-line; at certain conditions of high tide the water flows under gravity, but at low tide it is necessary to increase the flow by means of a booster-pump. To meet this condition two 16-in. centrifugal low-pressure verticle-spindle circulating pumps (each as a stand-by to the other), driven by 32-b.h.p. motors, are provided.

In case of fire aboard a ship when the dock is dry, two 8-in. two-stage centrifugal vertical-spindle pressure pumps, driven by 135-b.h.p. motors, are provided. These pumps supply water at a pressure of 120 lb. per sq. in. to a 10-in. diameter fire main, from which a connection is made to the fire-fighting appliances on the ship. The 12-in. diameter fresh-water main along each side of the dock is available for a further supply in case of emergency.

For draining the pump-chamber, two 4-in. house-pumps are provided.

The pump motors are placed at cope level so as to obviate damage to them should the pump-room be flooded as the result of an accident to the pump casings or branch pipes. All the pump motors, with the exception of those on the main pumps already described, operate on a 415-volt 3-phase 50-cycle supply.

Auxiliary Electric Supply.

The current for the dock, as elsewhere for the dock estate, is supplied by the Southampton Corporation. Should this supply fail during a docking or an undocking process it may be necessary to quickly close certain of the valves by power, and to meet this contingency two 125-kilovolt-ampere alternators, each driven by a four-cylinder vertical cold-starting Diesel engine, are provided, each being a stand-by to the other.

Pump Valves

A sluice-valve is provided on the suction and delivery branch of each pump. Those on the main pumps, and also on the delivery branch of the drainer-pumps, are electrically operated; the valves on the suction branches of the drainer-pumps are hand operated.

Each pair of the main pumps connects with a common discharge culvert, and in the event of one of a pair stopping while the other continued to run, or a failure of the current when the tide-level outside was higher than the water in the dock, there was a risk that damage would be done by a reversal of flow. To meet either of these contingencies, special apparatus has been provided to enable the valves on the delivery side of the main pumps to close under gravity in 15 seconds.

Culvert Valves

Valves Nos. 1 to 8, 12 and 13, and 19 to 22, on the suction, discharge, and impounding culverts, are 10-ft. in diameter. Nos. 9 to 11 are 6-ft. 6-in. in diameter, and Nos. 14 to 18 are 3-ft. in diameter. They are all electrically operated by separate motors housed in watertight chambers sunk below ground-level.

Control Gallery

Practically all the pumping-station operations are controlled from a gallery overlooking the whole of the motor-floor, and an illuminated diagram on the wall opposite the control desk contains a plan of the dock entrance with all culverts, main pumps, drainer-pumps, pump-wells, and main sluice-valves. Red and green signal lamps at each valve position on the diagram indicate whether the valve is open, half open, or closed.

Electricity Sub-Station

The station is also an electricity sub-station, equipped with transformers and converters for dealing with bulk supply.

Keel-Blocks

The keel-blocks are spaced at 2-ft. 3-in. centres, and occupy a length of 950-ft. 10-in. They are 16-in. wide and consist of five steel castings, the top and bottom castings being of uniform depth throughout and the remaining three tapered. A mild-steel tapered cotter in a slot through a lug on the thin edge of the centre wedge-casting is provided to correct any tendency for the latter to slip. The cast-steel blocks are surmounted by a 16-in. by 12-in. elm cap carrying a softwood pad. Three 1-in. diameter galvanised clench-bolts are provided to strengthen the elm caps against bursting pressure across the grain, and the elm caps are secured to the top castings by galvanised dog-bolts. Anchoring chains are fitted to fifty blocks at the forward end and to one hundred at the after end of the dock.

Keel-Block Tests

Two of the keel-blocks were tested to destruction in an 8,000-ton press at the Sheffield works of Messrs. Firth and John Brown, Ltd. They were mounted on a greenheart pad and the pressure was applied to the top through the medium of two steel blocks, having a combined depth of 12-ins., the lower block being 24-in. long by 16-in. wide, with rounded corners. Dial-gauges recorded the compression in the steel castings and the greenheart pad; compression in the elm cap was measured direct.

The results of the tests were as follows:—

	No. 1 Block	No. 2 Block
Centre clench-bolts in the elm cap failed at ...	1,067 tons	1,228 tons
Cast-steel blocks failed at	1,873 ,,	2,034 ,,

In the first block the centre clench-bolt was placed below the centre-line of the cap, and the elm was squeezed out to a considerable extent above the bolt; this caused the washers on the centre bolt to be forced out on their upper edges and the washers on the outer bolts to be forced out on their inner edges, resulting eventually in the failure of the clench-bolts both by tension and bending under the heads.

In the second block the centre clench-bolt was placed above the centre-line of the cap; in this case the elm did not squeeze out above the washer plates, and was therefore effectively constrained with the bolts in tension only.

The cast steel failed by direct compression through the top block. The wedge casting slipped $\frac{3}{32}$-in. in the first block and $\frac{1}{4}$-in. in the second block; the mild-steel cotters fixing the centre wedges were bent, but showed no signs of undue stress. The greenheart pad used in the first test stood up to the final load of 1,873 tons without any sign of distress, but that used in the second test split at the ends when the load had reached 1,389 tons.

Movable Bilge-Blocks

The bases of the movable bilge-blocks consist of steel plates and angles built in the form of a box-girder, the table being 16-in. wide. They are surmounted by two 16-in. by 12-in. oak

Southampton Docks Extension—continued

caps laid on the flat, secured to the bases by galvanised-steel straps and bolts.

Dock Cranes

The dock is equipped with an electric travelling crane on each side.

The crane on the west side is of 50 tons capacity at a radius of 110-ft., the speed of the hoist being 10-ft. per minute. A traverse hoist of 15 tons operates at 115-ft. radius with a hoist-speed of 33-ft. per minute. An auxiliary hoist of five tons operates at 125-ft. radius with a hoist-speed of 100-ft. per minute. The main hoist lowers under the control of a hydraulic brake, and the others are controlled by electric floating brakes. The jib is of the luffing type with an average luffing speed of 6-ft. per minute. The slueing speed is one complete revolution in 4 minutes. The gauge is 30-ft., and the crane travels under power at 25-ft. per minute. The crane rails are extended to the west wing-wall, so that heavy lifts can be taken out of a barge and placed in the dock.

The crane on the east side is of 10 tons capacity at 60-ft. radius, the speed of the hoist being 50-ft. per minute, with electric floating-brake control for lowering. It is designed for level-luffing at 60-ft. per minute. The slueing speed is $1\frac{1}{2}$ revolutions per minute. The gauge is 18-ft., and the crane travels under power at 50-ft. per minute.

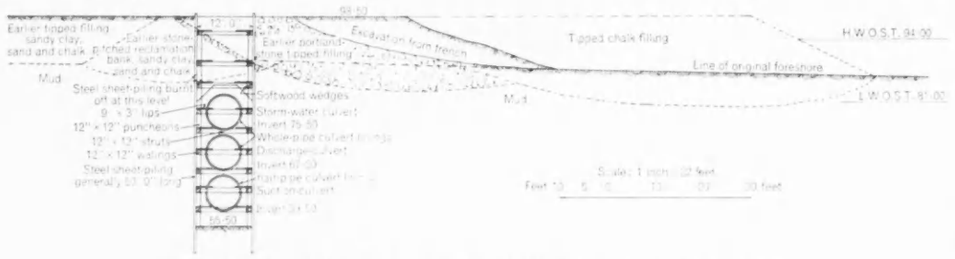

Earlier tipped filling sandy clay, sand and chalk
Earlier stone pitched reclamation bank, sandy clay, sand and chalk
Mud
Steel sheet-piling burnt off at this level
9" × 3" laps
12" × 12" puncheons
12" × 12" struts
12" × 12" wailings
Steel sheet-piling generally, 33'-0" long
Softwood wedges
Storm-water culvert
Invert 75·50
Whole-pipe culvert lining
Discharge culvert
Invert 61·50
Hamp pipe culvert lining
Suct on culvert
Invert 56·50
Excavation from trench
Earlier portion of tipped filling
Tipped chalk filling
H.W.O.S.T. 94·00
Line of original foreshore
Mud
L.W.O.S.T. 81·00
Scale: 1 inch = 22 feet
Feet 10 0 10 20 30 40 50 60 70 80 90 100 feet

Fig. 19. Cross Section of Trench and Culverts ("Vertical" System)

Caisson-Hauling Machinery

The caisson-hauling machinery is electrically operated and is placed at the western end of the caisson-camber. The main machinery and motors are housed in a brick building, with the barrel pinion-shaft extended through the walls at each side to the 7-ft. diameter main driving barrels in the open. The winding barrels are driven by two main motors (duplicates of each other), each capable of moving the caisson at the required maximum speed. The main motors are coupled to the common pinion-shaft by dog clutches, so that if one motor fails it can be immediately disconnected and the other brought into operation.

For the slow running of the caisson, the barrels are driven by two barring motors (again duplicates of each other), each capable of moving the caisson at the required slow speed. The barring motors are connected to the main gearing through double-reduction 10-to-1 gearing to give one-tenth of the full speed. Each barring motor is connected through its gearing, and finally through a friction-drive, to the main armature spindle, the friction drive being applied by a weight and released by a solenoid.

All motors being reversible, no reversing gear is provided. The slow speed of travel is $2\frac{1}{2}$-ft. per minute and the maximum 25-ft. per minute.

The control of each set of motors is carried out by three push-buttons, labelled "slow," "run," and "stop" respectively. When the "slow" button is pressed, the barring motor is connected in circuit and gradually brought up to speed, moving the caisson at the rate of $2\frac{1}{2}$-ft. per minute. After a travel of about 2-ft. the "run" button is pressed and the main motor is brought into action; the solenoid of the barring motor is then energized and releases the friction-drive, thus freeing the barring motor and handing over the drive to the main motor which gradually brings the speed of the caisson up to 25-ft. per minute. At about 2-ft. from the end of the travel the main motor is disconnected by means of a limit-switch, and the drive handed over to the barring motor, the solenoid being de-energized; the falling weight, which is controlled by a dashpot, gradually applies the friction-drive, the barring motor finishing the drive at $2\frac{1}{2}$-ft. per minute, and being finally stopped by another limit-switch operated by strikers at the end of the caisson. The controls for operating the various movements are placed at the front of the machinery-house, within easy control of one man standing in such a position as to have a good view of the working area.

The two hauling-ropes are $6\frac{1}{2}$-in. circumference specially-flexible galvanised plough steel, with manilla core. One end of each is secured to the camber end of the caisson direct, and after passing under and around the winding barrel, the rope passes over the barrel and around a 5-ft. diameter horizontal sheave sunk slightly below ground-level, and thence to a fixing on the camber end of the caisson; thus the ropes run over the tops of the winding barrels for hauling the caisson out of the camber, and on the undersides of the barrels for hauling it into the camber. The slack of the ropes is supported by rollers carried on steel frames, fixed to the walls of the camber.

Condensing-Water Culverts and Storm-Water Drainage

The former tidal mudlands extend up to the Southampton Corporation's electricity station, as shown in Fig. 3. Sea-water for condensing purposes was obtained from an adjoining cooling pond, which was replenished at high tide. As water access to the cooling pond would be cut off by the reclamation of the West bay, the Southampton Corporation required the Railway Company to provide culverts for the purpose of conveying from and to the estuary $4\frac{1}{2}$ million gallons of water per hour. Two culverts, each 7-ft. in diameter, were provided, one being for suction and the other for discharge, connected at the electricity station to a suction-trough and a discharge-trough respectively.

The Corporation also required the Company to extend the storm-water drains that formerly discharged on to the foreshore of the bay, so that they should discharge outside the line of the new quay-wall. These drains were dealt with in two sections, the first commencing at Southampton Central station and running eastwards, the second commencing about 700 yds. west of the Central station and running westwards. In both sections a new storm-water culvert was constructed to which the existing storm-water drains were connected. The positions of the culverts are shown in Fig. 1.

The new storm-water culvert for the first, or eastern, section was made 7-ft. in diameter throughout its entire length. From its commencement at Southampton Central station as far as the Corporation electricity station, a distance of about 340 yds., it was built in trench with a level invert at 86.50, and from thence was built (at a lower level) in the same trench as the condensing-water culverts for a further length of about 1,020 yds., where it diverges westwards so as to pass under the storm-water pumping station at the eastern end of the new quay-wall, as will be described later; the condensing-water culverts continued southwards, the one for a length of about 110 yds. to an intake, and the other for a length of about 190 yds. to an outlet. The intake and the outlet were built just outside the embankment enclosing part of the reclaimed area, and were placed as far apart as practicable to prevent warm water from the outlet re-entering the system through the intake.

By an arrangement of penstocks at the Corporation electricity station the two condensing-water culverts can be made interchangeable for supply or discharge, and, in addition, the storm-water culvert can be temporarily used as an emergency discharge-culvert for condensing water during the time that either of the condensing-water culverts is out of action for inspection, cleaning, or repair. Pipe connections to the three culverts permit sea-water to be supplied to the Southampton Corporation baths, and of the return of used water to the river. The baths can be filled by opening a valve connecting with the condensing-water discharge-culvert, as, owing to the hydraulic gradient between the discharge-trough at the electricity station and the tide the free level of the water in the discharge-culvert opposite the baths is always higher than the tide; conversely, they can be emptied at low tide by opening a valve connecting with the condensing-water suction-culvert, as owing to the hydraulic gradient between the tide and the suction-trough at the electricity station, the free level of the water in the suction-culvert opposite the baths is always lower than the tide. If it is desired to empty the baths at any time other than that of low tide, this can be done by opening a valve connecting with the storm-water culvert and pumping it out by means of the plant installed in the storm-water pumping station.

Storm-Water Pumping Station

Normally the flow in the storm-water culvert is gravitational, but in order to guard against flooding in the streets and property in the vicinity of the former foreshore and of the reclaimed land during a severe storm or high spring tide, or the coincidence of both, a storm-water pumping station (shown in Fig. 18) has been provided. The sub-structure of the station forms the eastern end of the quay-wall, and was constructed inside a single-skin steel-pile box-dam sunk through the tipped gravel bank.

The storm-water flows through the culvert which passes under the station, a multi-flap valve being provided to prevent back-flow of the tide. A float-control chamber near the Central station, connected to the pumping station by a land-line, contains apparatus which automatically gives warning in the station

Southampton Docks Extension—continued

of impending flooding and of the necessity of bringing one or more of the storm-water pumps into action.

The pumping equipment consists of three vertical-spindle single-inlet pumps, with 42-in. delivery and 45-in. suction branches. Electrically-operated sluice-valves are provided on the delivery and suction-side of each pump, and hand-wheels are also provided for use in emergency. A 14-in. vertical-spindle single-inlet drainer-pump and a 2-in. vertical-spindle single-inlet house pump are also provided.

The station is also an electric sub-station, equipped with transformers and converters for dealing with bulk supply.

Culvert Construction

The culverts were formed with pre-cast reinforced concrete linings, 7-ft. in diameter, 4-in. thick and 6-ft. long, surrounded by mass concrete. Where the culverts were built one above the other, as shown by Fig. 19, the lowest was formed by two semi-circular linings, as it was considered unsafe to strike enough of the lower trench-timbering to permit the bottom culvert lining to be placed as a complete circle.

From A to B the trench had to be sunk through an old bank of large rubble stone, about 10 to 20-ft. deep.

As originally designed the three culverts were placed one above the other, as shown in Fig. 19, and were so constructed between the points C and D on the plan. The trench was about 43-ft. deep. It was lined with steel sheet-piling, and was timbered with nine settings of 12-in. by 12-in. timber walings and struts, the latter being placed 10-ft. apart horizontally, and a single strut being used at the junction of the walings. Softwood wedges were used, and the struts were lipped and the walings puncheoned-up in the usual manner.

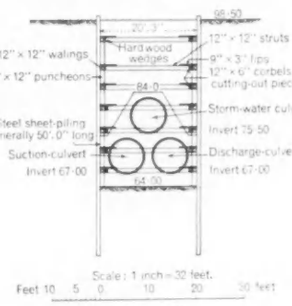


Fig. 20
Cross Section of Trench and Culverts ("Shamrock" System)

Prior to driving the steel sheet-piling the rubble stone was excavated in a runnered trench, the two or three top settings of timbering being placed. The runners were then withdrawn one by one, the steel piles substituted and driven to full depth by means of an automatic steam hammer. During the withdrawal of the runners a certain amount of stone, gravel and soil caved into the trench in certain places, and the cavities had to be made good after the piling had been driven.

Below the rubble stone the ground consisted of soft clays and peat, until a stratum of gravel was reached near the foundation-level; under the gravel was a deep bed of firm greensand. The water-content of these materials varied but, generally speaking, they were fairly dry in the undisturbed state. An appreciable quantity of water percolated through the interlocks of the steel sheet-piling from the rubble-stone bank, which was open to the tide, and as it fell into the trench it tended to soften the clays and greensand.

During the excavation of the trench it was noted that the pressure on the sides was very heavy, and in consequence of this, and the soft nature of the material in the core of the trench, increased perhaps by the action of the water which percolated into the trench from the rubble-stone bank, considerable bulging of the sides took place, the steel piles bending inwards, and the greater portion of the trench, particularly at the bottom, being less than the 12-ft. which had been intended. This appeared to occur mainly before the material could be excavated and the timbering inserted. The extent of the bulging varied, and in the narrowed part the trench was just wide enough to permit the culverts to be constructed, a better-quality concrete being placed around the lowest culvert in places when the width was less than that shown upon the contract section.

It was further noted that the trench had moved over at the top seawards, and this movement eventually reached a maximum of 4-ins. This seaward movement, or leaning over, of the trench was considered to be largely due to the fact that a few feet seawards of the trench the ground sloped away from the side of it down on to the mud foreshore, about 12-ft. lower than the ground on the landward side. It was therefore decided to form a bank around the foreshore, about 100-ft. wide, to provide support on the seaward side of the trench and to stabilise the ground generally; this was done by tipping out chalk from railway wagons.

In view of these experiences and the fact that some adjoining property was beginning to show signs of damage, it was decided to amend the design and to build the culverts in approximately "shamrock" shape, as shown in Fig. 20, using a heavier section of steel sheet-piling for lining the trench and driving it well below the bottom of the trench. As a further precaution, the timbering was strengthened-up by placing the frames closer together vertically, and in the lower four frames by using double struts at the junctions of the walings, with 12-in. by 6-in. cutting-out pieces at one end, and sometimes at both ends, of the struts. Hardwood wedges were used, the struts were lipped and the frames laced where necessary. Generally, the upper portion of the steel sheet-piling above the concrete was withdrawn, the lower part being left in, even where, as was the case in some parts of the work, timber foundation-piles had been driven. In this manner the work was satisfactorily completed. It meant, however, that the suction-culvert is permanently lower between the points C and D than elsewhere, and a special sump was provided at D for pumping out this portion when the suction-culvert has to be dried out for inspection.

Second Section of Storm-water Drainage

The second section of the storm-water drainage discharges under gravity at the west end of the quay-wall, but in cases of high tide or heavy storm, the discharge can be dealt with at the King George V Graving Dock pumping station, wherein warning is automatically given of impending flooding by apparatus provided in a flat-control chamber near Millbrook station.

Subsidiary Works

Passenger and Cargo Sheds

Eight brick-built single-storey passenger and cargo sheds, shown in cross section in Figs. 7 and 8, have been provided in four pairs lengthwise. They have a combined length of 5,890-ft., and a uniform width of 150-ft. Each pair is separated by a centrally-placed buffet and lounge for the use of passengers, with entrance doors from each of the adjoining sheds.

One railway line is provided inside the front of the sheds and one inside the back; on the latter all the passenger trains and most of the goods trains are dealt with. The shed-floors slope up from the level of the front line to 3-ft. 3-in. above the back, so as to facilitate the entraining and detraining of passengers, and the handling of cargo to and from rail. The doors along the front occupy 50 per cent. of the length. A balcony for the use of the public is provided along the greater part of the front of each shed.

Carriage-Cleaning and Warming Shed

A brick-built carriage-cleaning and warming shed, 760-ft. long by 98-ft. wide, has been provided. It has six lines of railway track, each capable of accommodating one twelve-coach special train. Here the trains are warmed by steam before they are shunted into the sheds for passenger use, and the building is further equipped with the means for replenishing the train water-tanks, and for supplying gas to the kitchen cars for cooking purposes.

Railway Sidings

Two lines of sidings have been provided along the entire length of the new quay; these connect with three lines behind the passenger and cargo sheds, and all connect with groups of sidings further landwards arranged as "reception inwards," "marshalling inwards," "marshalling outwards," and "departure" sidings. At present only the nucleus of these groups has been provided, with space to add to them as and when necessary. Altogether 26 miles of 90-lb. per yard chaired track have been laid on the new estate.

Vehicular Roads

The easternmost length of 400 yds. of Herbert Walker Avenue was made with hand-picked limestone foundation, hoggin, and rolled tar-macadam. Except for this, all the vehicular roads were made of concrete. They were laid for the full width in alternate lengths of 20-ft., the primary lengths being formed with transverse screeds and acting as screeds for the secondary lengths after setting. Plain butt-joints were adopted transversely, each joint resting centrally on a concrete pad 24-in. wide by 7-in. deep, extending across the full width of the road. A strip of bituminous felt was secured across the face of each of the transverse joints after the primary lengths had set, to form expansion-joints.

As expected, the roads have sunk in places owing to the settlement of the reclaimed land; in such places the surface has been brought up to level where necessary with tar-macadam.

Conclusion

The works were designed and carried out under the direction of Mr. F. E. Wentworth-Sheilds, O.B.E., M. Inst. C.E., then Docks Engineer, Southern Railway, under whom the Author served as Chief Assistant.

Messrs. Coode, Wilson, Mitchell and Vaughan-Lee, MM. Inst. C.E., were consulted when difficulty arose in sinking the quay-wall monoliths, and in the construction of the storm-water and condensing-water culverts; in connection with the latter, Messrs. Mott, Hay and Anderson, MM. Inst. C.E., were also consulted.

Southampton Docks Extension—continued

Mr. H. Wauchope, the Company's Dock Electrical Engineer, was responsible for the installation of the electrical equipment, mains and services.

The principal works and some of the subsidiary works were carried out under contract; the railway sidings, vehicular roads, drains, water and gas mains, etc., were carried out under direct administration by the Docks Engineer's Department.

A special staff was formed for the design and execution of the works; particular mention should be made of:—Mr. E. W. Beare, B.Sc. (Eng.)., M. Inst.C.E. (Senior Assistant and in charge of design staff); Mr. G. E. C. Callow, B.Sc., M. Inst.C.E. (in charge of the construction of the quay-wall and the passenger and cargo sheds); Mr. Frank Whyte, M.C., B.Sc., M.Inst.C.E. (in charge of the construction of King George V graving dock); Mr. V. R. Husband, B.Sc. (Eng.), Assoc. M. Inst. C.E. (in charge of dredging and reclamation); Mr. Cecil Peel, B.Sc. (Eng.), Assoc. M. Inst. C.E. (in charge of the construction of the storm-water and condensing-water culverts); Mr. D. J. MacG. Williamson, Assoc. M. Inst. C.E. (in charge of the western section of storm-water culverts); Mr. W. J. Sinclair, Assoc. M. Inst. C.E. (in charge of work carried out under the Railway Company's direct administration).

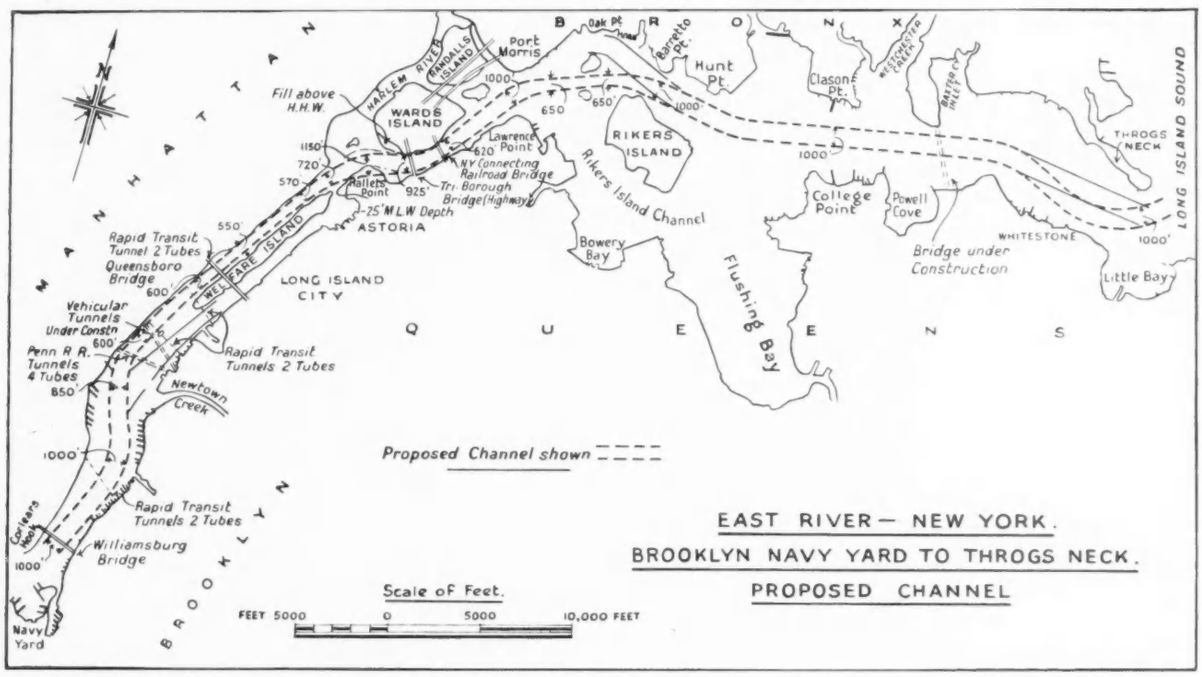
The Contractors for the principal works, and their representatives on the site, were:—

Dredging and reclamation.	The James Dredging, Towage & Transport Company, Ltd. (Mr. G. H. James and Mr. G. H. A. Pursey).
Quay-wall, and passenger and cargo sheds.	Sir Robert McAlpine & Sons (London), Ltd. (Mr. T. G. B. McAlpine and Mr. Donald Mackenzie).
King George V graving dock and western section of storm-water culverts.	Messrs. John Mowlem & Company and Edmund Nuttall, Sons & Company (Joint), Ltd. (Mr. E. M. Fitt, B.Sc., M.Inst.C.E.).
Caisson at King George V graving dock.	The Furness Shipbuilding Company, Ltd. (Mr. J. H. Cross).
Artesian-water wells at King George V graving dock.	Messrs. Siemens-Schuckert (Great Britain), Ltd. Herr Helmut Wehe).
Storm-water and condensing-water culverts.	Messrs. Charles Brand & Sons, Ltd. (Mr. J. M. M. Howat, Assoc. M.Inst.C.E.)

Corrigendum.—Fig. 7 (Monolith Quay Wall as originally designed) should read—"Monolith Quay Wall as modified," and Fig. 8 (Monolith Quay Wall as modified) should read—"Monolith Quay Wall as originally designed." (See July issue.)

Improvement of Navigable Channel at East River, New York

The navigation of East River on the Eastern side of Manhattan, which connects the Hudson River with Long Island Sound, has long presented serious difficulties, and the dangers of Hell Gate prior to the gigantic blasting operations of nearly seventy years ago, were notorious. The conditions are not yet sufficiently satisfactory for modern requirements, and on February 24th last a public inquiry was held in New York to obtain information for the purpose of a review of reports on the East River submitted in Committee of U.S. Congress "with a view to determining whether any modification in the existing project for East River from Brooklyn Navy Yard to Long Island Sound (Throg's Neck) is advisable at the present time."



In 1936, the Navy Department submitted for consideration a plan for further improvement of this waterway. Since that date, an extensive model study was made, which resulted in a slight modification of that plan.

Elimination of difficulties attending navigation in the vicinity of Hell Gate is the most important phase of the scheme. The model study has developed for this locality a channel alignment most nearly meeting the requirements of the Navy. The outline of the channel recommended by the Navy Board is shown on the accompanying plan.

The views of commercial navigation interests were particularly desired as to the adequacy of the following general recommendations of the Navy Board:—

(a) To deepen the East River channel to a depth of 40-ft. at mean low water from the Navy Yard to Throg's Neck.

(b) To widen the foregoing channel to 1,000-ft., except where limited at Blackwells Island, Wards Island, and between North and South Brothers Islands, to minimum widths of 550-ft., 620-ft. and 650-ft. respectively.

(c) To remove Hallets Point at Astoria so as to provide a maximum channel width of 1,150-ft.

(d) To adjust channel alignment through Hell Gate by means of the following:—

(1) To dredge to 25-ft. to round south-west corner of Hallets Point.

(2) To over-dredge the channel through Hell Gate to 47-ft.

(3) To deposit fill in the vicinity of Hog's Back.

(4) To dredge to 40-ft. the ledge near Mill Rock, and the ledge along the east bank between the Hell Gate and Triborough bridges.

In order to determine whether further improvement of East River was justified in the interest of commercial navigation, answers to the following questions were solicited:—

(1) What average annual tonnage was to be expected to ship via East River if that waterway were improved?

(2) What, if any, would be the average unit saving?

The report on the survey for the proposed improvement will be presented to the U.S. War Department in due course.

Proposed Fishery Basin at Whitby.

The proposal to construct a basin in the Dock End area of Whitby upper harbour, to serve as a shelter for the fishing fleet, has received favourable consideration, and the Treasury has granted the sum of £3,500 from the Development Fund towards the cost of building a jetty. It is hoped that work on the scheme will be started in the near future.

Notes of the Month

Quick Cargo Discharge at Port Talbot.

The Swedish steamer " Torne " discharged at Port Talbot on July 30th, a cargo of 5,600 tons of iron ore within a period of 11 hours 20 minutes.

New Lightship for the Tay Estuary.

An order for a steel lightship, to be named the " Abertay," was placed recently with Messrs. The Caledon Shipbuilding and Engineering Co., Ltd., of Dundee. The lightship will replace a wooden vessel which has been in service at the Tay Estuary since 1877.

Extensions at the Port of Odense, Denmark.

The Town Council of Odense has decided upon further improvements to the facilities of the port at an estimated cost of 4,000,000 kr. The scheme will take about four years to complete and ultimately the length of the quayage will be increased to a total of 3 kilometres.

Manchester Ship Canal.

The approximate traffic receipts for the month of July amounted to £108,000 compared with £113,650 for July, 1937, a decrease of £5,650. The aggregate receipts for the seven months of this year were £766,539, a decrease of £12,682 compared with the corresponding period of last year.

Port Extension at Singapore, Straits Settlements.

The wharf extension at the Port of Singapore was officially opened at the end of July, by Sir Shenton Thomas, the Governor. The work has cost £1,000,000 and was recommended by the Imperial Shipping Committee in 1929. With the new extension, the port now has a total of 2½ miles of continuous berths.

New Turkish Port.

It is announced that the Turkish Government have decided to construct a modern harbour at Tchatalagzi, near Zonguldak, on the Black Sea. The cost is estimated to be about £2,000,000, and the new port will be used chiefly for the transportation of coal from the rich Turkish coalfields. Work on the project is to be started without delay.

Port Facilities at Beira.

At the annual meeting of the Port of Beira Development, Ltd., held recently, it was stated that progress had been made with the construction and equipment of a fourth deep-water berth, 600-ft. in length, and also on various other works, including the construction of two large transit sheds. In view of the continued increase in trade, steps have been taken for the construction of a fifth deep-water berth.

Traffic at North Sea Ports.

Shipping at Hamburg and Bremen has further increased during the current year, the greatest improvement during the first six months being recorded by Bremen. Arrivals amounted to 4,278 vessels and totalled over 5,000,000 tons, an increase of 599 vessels and 673,000 tons. Arrivals at Hamburg amounted to 9,243 vessels, aggregating 10,161,000 tons, an increase of 518 vessels and 622,000 tons, compared with the first six months of 1937. Rotterdam also showed a small increase of 99,856 tons or 0.8%, but the inwards traffic at Antwerp declined by 455,000 tons or 4.5%.

New Graving Dock at Colombo.

On Monday, July 18th, Sir Andrew Caldecott, the Governor of Ceylon, officially opened the new graving dock at Colombo which has been under construction since August, 1935, and has cost £100,000. The new dock, which has an effective length of 350-ft. and a width of 87-ft., with a depth over the sill at high water of 22-ft., has been built at the inner end of the former graving dock and provides a valuable and much-needed addition to the docking facilities of the port, particularly for repairs to vessels of the smaller class, such as tugs and dredgers. The hydraulically-operated flap-gate was supplied by Sir William Arrol & Co., Ltd., of Glasgow, and was shipped in sections to Colombo, where it was erected, launched and floated into position. The work on the dock involved the partial removal of the end wall of the existing lock and the excavation of about 74,000 cubic yards of material, and the construction of approximately 25,000 yards of concrete work. The greater part of the material excavated was utilised for the reclamation of swamp areas in the neighbourhood of the harbour. The whole of the work was carried out departmentally, under the direction of Mr. T. A. Owles, the Harbour Engineer. Messrs. Coode, Wilson, Mitchell & Vaughan-Lee, of Westminster, London, being the consulting engineers to the authorities.

Klaipeda (Memel) Free Port.

Negotiations of far-reaching importance to the Polish timber export trade, have been concluded by an agreement between Kovno and Warsaw for the establishment of a Polish free port at Klaipeda (Memel).

Disastrous Port Fire.

The greater part of the old Port of Gravelines, France, consisting of wooden piers and wharves, has recently been destroyed by fire. The damage is estimated at more than £100,000.

Danube Navigation.

An agreement between Great Britain, France and Rumania has lately been signed, by which Rumania will control the execution of new works in the region of the mouths of the Danube and the zone between Braila and Sulina. The adherence of Italy to the agreement is expected.

New Dry Dock for Lourenco Marques.

According to information received with reference to the proposal to construct a dry dock at Lourenco Marques, Portuguese East Africa, a survey has been ordered, and local investigations are being made by the technical staff regarding a suitable capacity of the dock and the best position in which to place it.

Graving Dock Opened at Callao, Peru.

The Callao Graving Dock, commenced in May, 1936, has now been completed and handed over to the Government. Situated under the lee of the north breakwater, the new graving dock has been constructed throughout of reinforced concrete and can accommodate vessels of up to 636-ft. in length and 10,000 tons displacement. The general dimensions are as follows:—Overall length 656.17-ft., overall width 107.58-ft., width between walls 79.11-ft., depth of water over the sill 25.97-ft.

Oil Port Deepened at Malmo.

The Malmo Port Authority recently placed a contract for deepening the oil port to 9.25 metres (30.4-ft.). The Authority is also considering certain measures for the safeguarding of inward and outward shipping, including a radio-beacon in the entrance channel. It is understood the Authority is at present awaiting the result of certain experiments now being conducted by the Pilot Board with one of the radio-beacons.

Telephone Service for Ships in Port.

A further development in dock telephone facilities was inaugurated during the latter part of last month, when eight unallocated berths in the South West India Docks were equipped with portable telephone sets. Many of the berths allocated for the specific use of particular shipping lines have been similarly equipped for some years. The new facility has been provided by the Post Office in co-operation with the Port of London Authority. In future the Master of a vessel docking in the South West India Docks, on application to the P.L.A. Departmental Officer, will be able to have a telephone installed on board immediately the vessel is berthed.

Floating Dock for Durban, South Africa.

Constructed to the order of the South African Railways and Harbours Administration, the largest floating dock ever built on the Tees was launched recently by Messrs. The Furness Shipbuilding Co., Ltd., of Haverton Hill. When fully equipped, the dock will weigh 4,000 tons, and will be capable of lifting a vessel of 4,000 tons displacement and 17-ft. 6-in. draft, in 80 minutes, by means of electrically-operated pumps and machinery. The overall length is 350-ft., with a width of 88-ft., and a clear width between fenders of 63-ft. 11-in. After carrying out a series of sinking and raising tests, the dock will be towed to Durban, South Africa, a distance of 7,000 miles.

Improvements Contemplated at the Port of Dunkirk.

Further plans for the improvement of the Port of Dunkirk have been prepared. As soon as the new outer harbour is completed and ships are able to use the new entrance, the old wooden pier to the west will be demolished. As 1,200,000 tons of liquid fuel is handled by the port each year and ships bringing the fuel have to berth alongside quays which could be used to advantage by other traffic, the oil dock is to be improved and a canal is to be cut to enable ships to gain access to the oil dock. The construction of a new lock for internal navigation has also been decided upon and a new graving dock is to be built, capable of accommodating ships of up to 300 metres (984-ft.) in length. The textile shed is also to be enlarged and the Mardyck Canal remodelled and lengthened.

European Commission of the Danube

Measures Proposed at the Sulina Mouth

A work of no little interest and importance from the point of view of navigation and river improvement, is being, and has been for many years past, carried on by an international body, called the European Commission of the Danube. The River Danube, a noble stream, 1,750 miles in length, traversing the Continent of Europe from Southern Germany to the Black Sea and in its main course above Isaktcha, possessing a channel 1,000-ft. wide and 50-ft. deep, breaks up on approaching the Black Sea into three main branches, or arms—the Kilia arm to the North, discharging through numerous mouths; the Sulina arm, a single stream at the mouth of which stands the Port of Sulina; and the St. George's arm, also a single stream lying to the South of the other two.

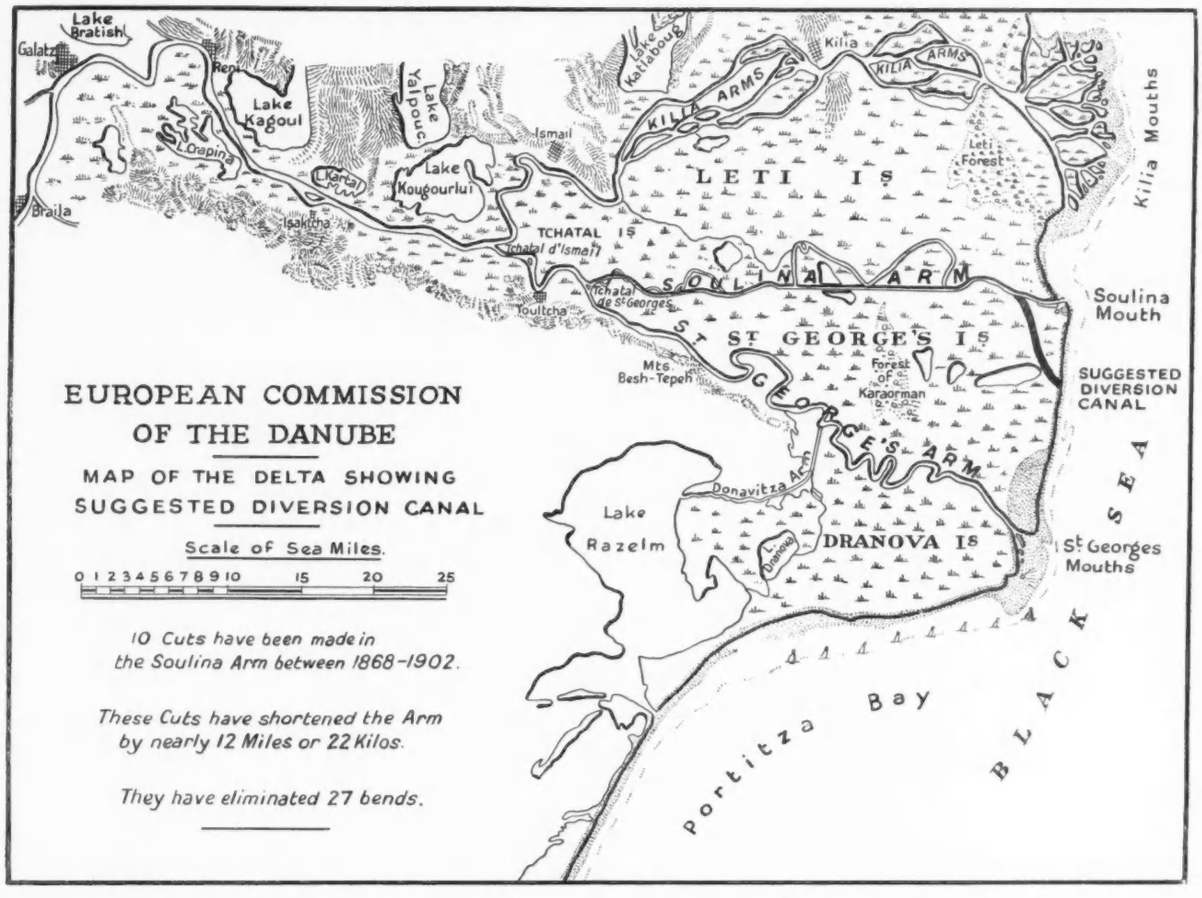
The Commission was instituted in 1856 with the object of improving the navigable waterway for the traffic in grain and other commodities which passes from Central Europe. It was charged with the execution of such works as might be desirable for freeing the river mouths from the accumulation of silt and detritus which interfered with the passage of vessels.

Two views can be held at the moment on the probable, or possible, development of the situation.

One is that the conditions now obtaining will persist for an indefinite period in the future, and that the Southward trend of detritus from Staroe Stamboul will be maintained, leading inevitably to the ultimate closure of the Sulina entrance. Indeed, this result may even be contemplated as occurring within a moderate period of years, perhaps less than twenty, in which case the only practicable course would be to construct a new cut, or channel (see plan), for the Sulina arm, Southward of the existing arm, with the formation of an outlet some distance to the South at a point in the coastline which is under the influence of favourable wave action and littoral currents, such as to render remote the possibility of the new entrance channel being adversely affected by deposits from the Staroe Stamboul mouth.

The other view is that before the detrimental effect on the present Sulina outlet is likely to become acute, certain natural agencies which have been observable latterly will, in all probability, produce a divergence of the Kilia deposits in an Easterly direction, so that the Southward trend of accretion will cease, or at any rate become so moderate in amount and extent as to give no cause for concern.

The first of these views, if adopted, would lead to a



As the earlier history of these operations has been the subject of notice in this Journal (vide: issues of February, 1921, March and October, 1925, and September, 1926), it is not necessary to dwell upon the reasons which led to the choice of the Sulina mouth for treatment, in preference to the other two, nor to do more than say that, in 1921, a channel from the Port of Sulina had been dredged in a North-easterly direction with a ruling depth of 24-ft. Very shortly thereafter, this channel was hampered by shoaling due to sediment from the Kilia mouths accumulating in the coastal embayment in this locality, and a new channel was thereupon created, by dredging and training works, leading in a directly Eastward direction. This channel, achieved by the year 1926, has since been in service for purposes of navigation in approaching and leaving the port, and though the standard depth of 24-ft. has not always been maintained, yet at the present time it is actually available.

Further encroachment of sediment from the Kilia arm, and more particularly from the Staroe Stamboul outlet, has of late been much in evidence and, in fact, the matter has assumed a phase in which there is a threat of interference in the future with the use of the Sulina mouth. The rate of progress is not such as to justify immediate alarm, but as it has been steady and continuous, the existence of the problem has come to be recognised as calling for present consideration.

considerable outlay in the formation of the new cut, and it would have other disadvantages in a disturbance of the present regimen, both physical and commercial, so that it seems very desirable before embarking on so considerable and drastic an undertaking, that some further time should be allowed to elapse in order to enable the tendencies, mentioned above in connection with the alternative view, an opportunity of developing. By a careful watch on the progress of the Kilia mouths it could be determined with greater confidence whether the threat to the Sulina mouth would become actual instead of potential, and in the course of a short space of time a decision could be made on the necessity or otherwise, of forming the new cut and outlet.

This is, in fact, the course which is being adopted by the Commission and the result of their important investigation will be awaited with much interest. The delay will not be prejudicial, in any way, to the execution of the new cut, should it be found necessary, since the constructional proposal entails a good deal of preparatory study in its earlier stages which can be carried on simultaneously with the observations at Saroe Stamboul and the Kilia mouths generally.

The technical members of the Commission are Mr. A. T. Coode, M.Inst.C.E. (England); Monsieur P. Barrillon (France); Professor Coen Cagli (Italy); and Monsieur I. Vardela (Roumania).

The River Clyde and the Harbour of Glasgow*

By A. C. GARDNER, F.R.S.E., M.Inst.C.E., M.I.Mech.E.
President of the Institution of Engineers and Shipbuilders in Scotland

(concluded from page 288)

Improvements in Ancillary Services

Of the three graving docks owned by the Trustees, the largest is 880-ft. long, with an entrance width of 83-ft. This dock was originally divided at about mid-length into two compartments by a raised sill and a centre pair of gates, and although constructed at the beginning of the period under review, has recently been greatly improved by the lowering of the floor a matter of 1-ft. 8-in. throughout its length, thus increasing the working depth under the hull of a ship. The work incurred a rearrangement of the drainage system of the dock, and involved putting the inner gates permanently out of commission, and the removal of the inner sill, but it has amply repaid the expense incurred, and greatly facilitated both docking and repair.

JOHN WILSON, Esq., General Manager and Secretary, Clyde Navigation Trust, and Secretary, Clyde Pilotage Authority.

It is impossible within the compass of this paper to do more than refer very briefly to the great changes and improvements which have been made in the mechanical equipment of the port. Electricity has largely replaced other forms of power throughout the harbour, and among a total of 105 cranes belonging to the Trustees, 14 have a lifting capacity of 25 tons and over, including two of 130 tons and a giant cantilever crane recently provided for the fitting out of vessels at Finnieston Quay, capable of lifting 175 tons at a radius of 80-ft. All these appliances are in addition to cranes owned and operated by those shipping companies which occupy appropriated berths in the harbour.

Although various schemes have been put forward for the construction of a high-level bridge across the harbour, for which Parliamentary powers have been obtained, no commencement has yet been made on that work, and cross-river communication below the King George V Bridge is still mainly effected by passenger and vehicular ferries operated by the Trust. Three modern, self-propelled, high-level adjustable deck ferries are provided at Finnieston, Govan and Whiteinch, and two chain ferries at Renfrew and Erskine, in addition to a large number of passenger ferry services elsewhere in the harbour. The adjustable decks on the ferries above referred to are suspended on six large screws, operated by an engine, which lift or lower the deck as required to suit the varying state of the tide. As an indication of the volume of traffic dealt with, it may be stated that during the past year 297,880 vehicles were dealt with on the Renfrew Ferry alone.

Another important addition made to the undertaking in the period referred to was the construction of the Trustees' new workshops on the south side of the river at Renfrew (No. 18 on Supplement). In 1905 the Trustees had acquired by purchase the Renfrew Harbour undertaking and land to the eastward of the harbour, and in 1908 transferred their workshops from Dalmuir on the north side of the river to that site. These works are very extensive, and are provided with wharves on the river front and in the harbour, together with slipways enabling them to carry out all repairs to their extensive dredging fleet and the floating craft for which they are responsible. The yards and workshops, which are equipped with up-to-date machinery, cover an area of ten acres, and in them are carried out all the repair and maintenance services required for the upkeep of the Trustees' cranes and mechanical appliances throughout the harbour, as well as the buoys and lights in the river channel.

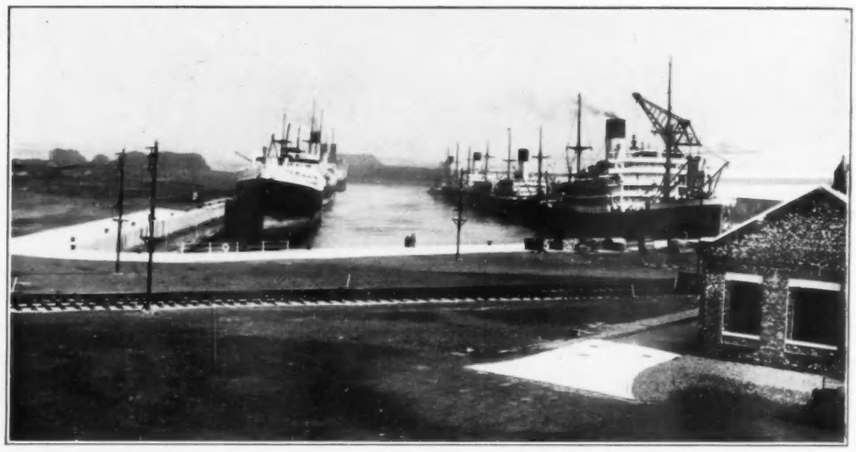
Reference has been made to the recent extension of the Trustees' Granary at Meadowside. Space will not permit of a detailed description of the new structure, which is a brick and stone-faced ferro-concrete building 141-ft. long, 75-ft. wide and 163-ft. above ground at the working house end. There is a low connecting structure between the new and existing buildings, serving to connect the conveyor tunnels, loading platforms and sacking-off floors, and three connecting gantries at higher levels. The silos are 11-ft. 6-in. square with 7-in. walls, arranged in six longitudinal rows of ten bins, with four extra bins at the sides of the working house, making 64 silos in all. The two outer rows of silos on each side of the building are 82-ft. high, and the two central rows 100-ft. high. A sectional elevation of the new building is illustrated on pages 328 and 329. The total storage capacity of the extension is approximately 15,000 tons, and the combined capacity of both buildings 46,000 tons. The new building is supported on a concrete raft foundation 3-ft. thick, 150-ft. long and 86-ft. wide, founded in step formation on the boulder clay, which declines eastwards to a depth of about 34-ft. below ground level. From this raft concrete piers 7-ft. 6-in. square at 12-ft. centres in both directions are built up to carry the internal columns which support the silos, and a continuous mass concrete wall 4-ft. in thickness supports the outer columns and walls of the building. The internal columns, which are octagonal in section, each carry a maximum load of about 430 tons. They are heavily reinforced, and constructed of 1-1-2 concrete, for which a working stress of 1,000 lb. per sq. in. was adopted, the concrete in all other parts of the structure being designed for a stress of 800 lb. per sq. in. in direct compression, or 1,000 lb. per sq. in. where the stress is partly due to bending. The concrete in the columns, floors and beams was vibrated with mechanical vibrators in order to obtain the maximum possible density and strength. Ordinary mild steel was used throughout for the reinforcement, for which a working stress of 18,000 lb. per sq. in. was used. The brick facing is 14-in. thick, except in the panels, where it is only 4½-in. thick. Great care was taken to ensure an adequate bond between the ferro-concrete structure and the brick facing.

175 Ton Cantilever Crane, Stobcross Quay.

*Paper read at the International Engineering Congress, Glasgow, on June 21st, 1938.

The River Clyde and the Harbour of Glasgow—continued

This was obtained by forming toothings of 1-in. projection on the back of the brickwork by the use of special headers, both in the panels and piers, and by galvanised iron ties built into the joints and running into the ferro-concrete work at the rate of six per super yard, and by casting the concrete against the brickwork as a shutter, which in itself provided a substantial degree of adhesion. Artificial stone was used for copings, cornices and string courses, this also being secured by iron ties to the ferro-concrete work.



King George V Dock, Shieldhall

In view of the certainty of some settlement occurring during construction, and again when the silos are filled with grain (more than equal to the deadweight of the structure) it was considered desirable to take no bearing at all upon the existing granary building. In consequence, all the connecting structures, conveyors, subways, floors and roof at the lower part of the building, as well as the galleries towards the top, were cantilevered out from the new structure, and chases were cut to receive them in the old work to allow settlement to take place without damage to either building. Above the level of the steel hopper bottoms the walls of the silos and of the working house were constructed with moving forms, provision being made for the subsequent erection of the floors in the working house. The building, which was commenced in April, 1937, and in which the machinery is now being installed, is expected to be in full working commission this summer. The ship discharging plant consists of three travelling elevators on the quayside, two pneumatic and one of the bucket type, each of a capacity of 250 tons per hour, which deliver the grain through underground conveyor tunnels into the granary building. Delivery from the granary can be given either in sacks or in bulk to road vehicles and railway wagons or to lighters at the quay. A sectional scale working model of the building is on view in the Exhibition.

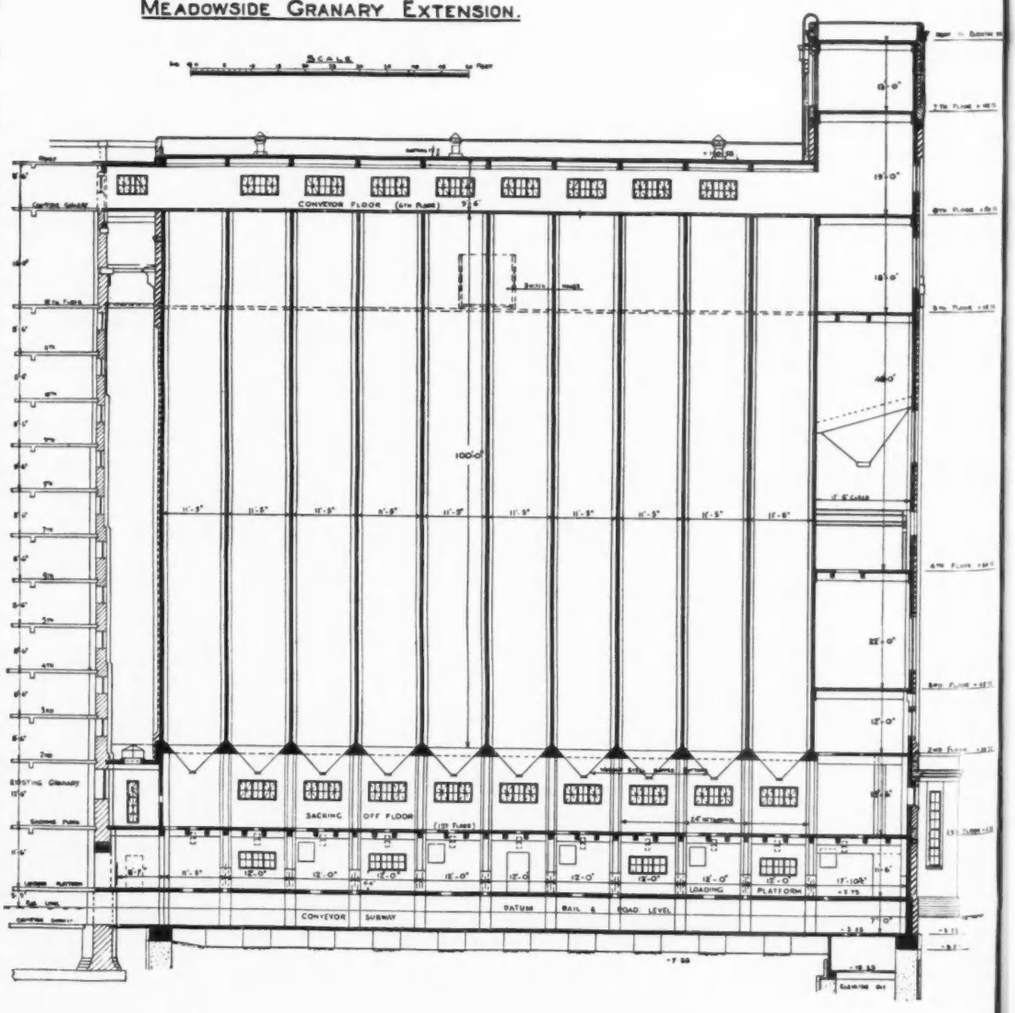
Improvements in The River Clyde.

Finally we come to the consideration of the river on which the various works described have been carried out.

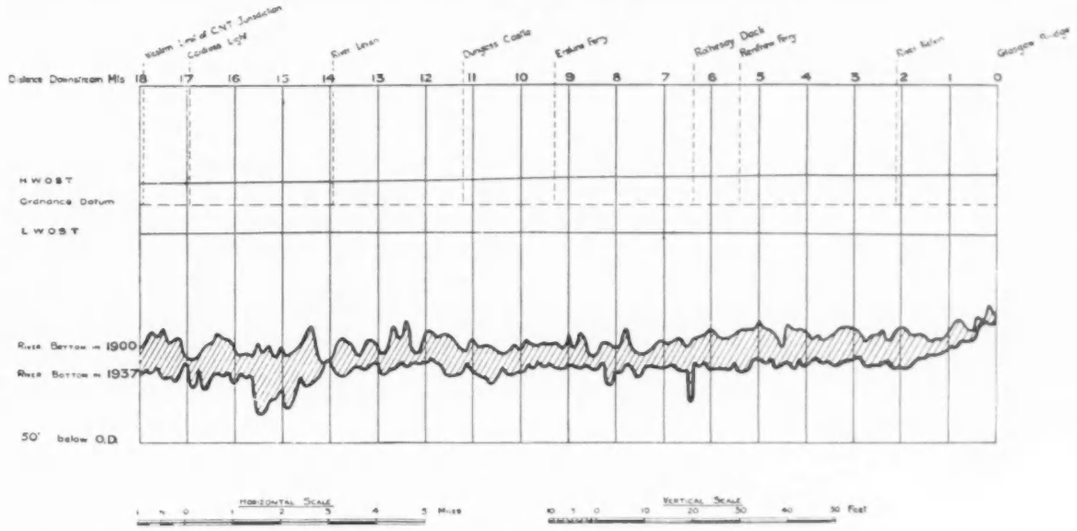
The early history of the Clyde is familiar to most engineers who have to do with the maintenance of navigable waterways, and was reviewed by the author's predecessor in the address to which reference has been made. Continuing its engineering history from that point, it is necessary to record the subsequent improvements which have been made during the present century by the Clyde Trustees, who are charged with the responsibility of maintaining the river for a distance of 18 miles seaward.

These improvements fall generally under the two main headings, that of widening and that of deepening. With regard to the first, the various widenings which have been carried out since 1900, or which are now being carried out, aggregate a total length of seven miles, and represent average widenings of about 100-ft. to the deep-water channel of the river. Normally, in open reaches, the work consists of setting back the dyke or embankment by the amount represented by the widening of the channel, and preserving the existing underwater slopes near the banks in the process of dredging. In other cases, where the acquisition of land sufficient to enable the slopes to be preserved is not practicable, recourse has to be made to sheet piling the bank at the foot of the dyke at or near low-water level. The dykes themselves down to that level are faced with stone pitching grouted in place, thus giving the Clyde for a considerable distance the general appearance of a canal. In the process of widening the river at those places where necessity has required it to be done, due regard is paid to the hydraulic requirements of the river in order to preserve, as far as possible, the present balance of its tidal compartments, so as not to disturb the time arrival or the duration of high water at Glasgow. These factors have, of course, suffered many variations since the first attempts were made to improve the river. In 1768, for instance, the time interval elapsing between high water at Gourock and high water at Glasgow was recorded by Golbourne as being two hours. To-day it is only 45 minutes,

MEADOWSIDE GRANARY EXTENSION.



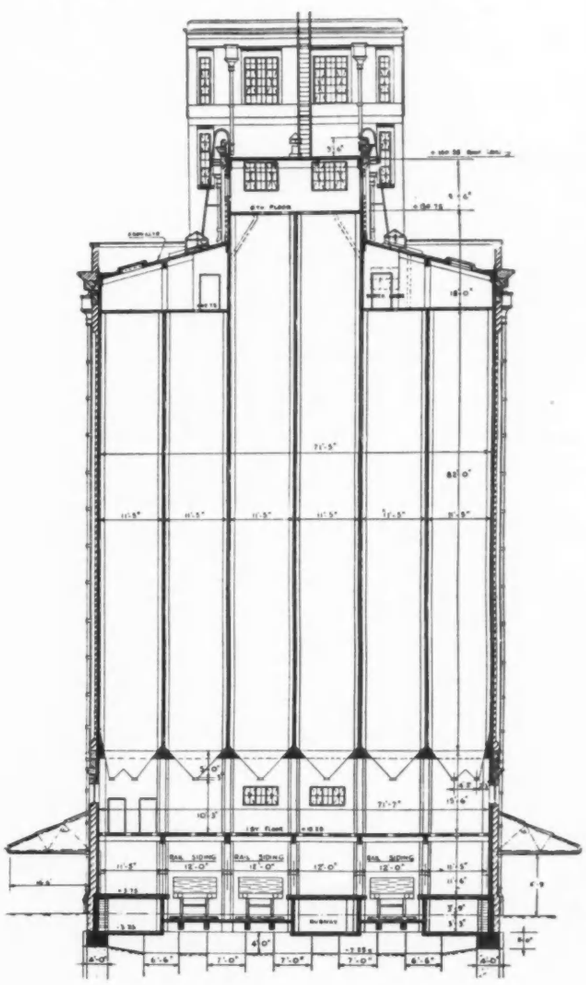
The River Clyde and the Harbour of Glasgow—continued

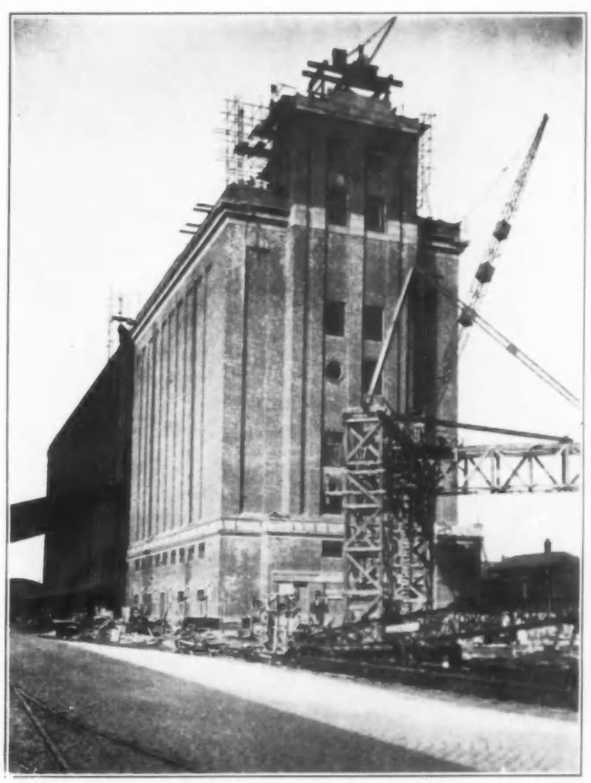


but the duration of the tidal flow has perceptibly lengthened, having increased by 1½ hours during the last 100 years, whilst the duration of the ebb in the river has been shortened by about the same length of time. It is interesting to observe, at this point, that high water at Glasgow has remained constant as far back as any records show, but the range of the tide, which was then only 1-ft. 9-in., has now reached 12-ft. 6-in.; that is, low-water level at Glasgow has fallen by 10-ft. 9-in., owing to the progressive deepening and widening of the river.

Undoubtedly one of the greatest public improvements affecting the river during the period under discussion has been the scheme of sewage purification carried out by the Corporation of Glasgow, which was completed at great cost, but with correspondingly great benefits to the community and the river. Other purification schemes are now being carried out by the smaller townships on the Clyde and its tributaries, which, in turn, will further contribute to the general preservation of the amenities of the river.

The deepening of the river to keep pace with the growing dimensions of vessels has engaged the constant attention of the Trustees, and this work has proceeded continuously. The chart at the top of this page shows the deepening of the river within their jurisdiction which has been effected during the present century, representing an average lowering of the river bed by about 6-ft. and the removal of 120,000,000 tons of material. At the beginning of that period, in consequence of the increasing draught of vessels, it was realised that it would be necessary to resume operations on the removal of the Elderslie Rock—a major obstruction first encountered in 1854—in order to provide greater depth for navigation at low water. The area of the rock in question was 5½ acres, and by 1907 the work had been completed by drilling and blasting, and the rock reduced to a low-water depth of 28-ft. over the whole area. In the process of widening the river during the last few years, rock has been encountered at another point, which, in this instance, and with the modern appliances now available, was removed by means of a rock breaker operating with a 10-ton ram, the surface of the rock being finally levelled off with small explosive charges by means of a diving bell.

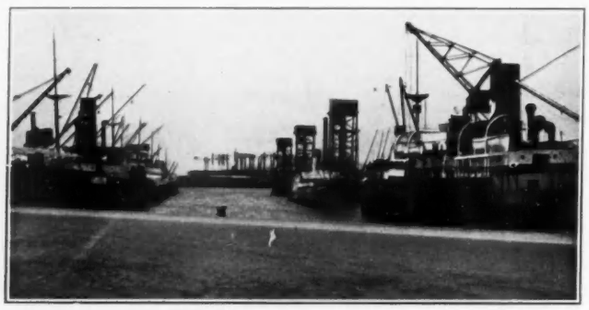




Meadowside Granary Extension approaching completion

The River Clyde and the Harbour of Glasgow—continued

Not the least important of the duties devolving upon those responsible for the channel of the Clyde arises from the special requirements of the river as a shipbuilding centre, and the provision needing to be made from time to time for the launching and passage to sea of ships of large and frequently exceptional dimensions.



Rothesay Dock Coal Hoists

At the beginning of the century, the largest vessel on the high seas was the famous White Star liner "Oceanic," with a total length of 705-ft., and a beam of 68-ft. In each decade since that time, the largest liners have increased in length by about 100-ft., and although cargo vessels have not increased to the same extent, it is now necessary to provide depths up to 30-ft. of water to accommodate the largest vessels of the trading class. There can, of course, be no finality in the progress of naval architecture or engineering, but the price of progress in the size and draught of ships is a very heavy one when the burden of cost on Harbour and River Authorities is taken into account. Few have evaded their responsibility when the need has arisen, least of all the Trustees of the Clyde Navigation, who have bent their energies to the development and improvement of the river in the interests of the shipbuilding industry for which the Clyde has become so justly famous. As an indication of the demands made upon the river, it may be mentioned that during the past year no fewer than 112 vessels were launched from the various shipbuilding yards on its banks, representing about 40 per cent. of the total tonnage launched from British yards. Its crowning achievement was the launching and passage of the "Queen Mary," to be surpassed this year, it is hoped, with similar success when her sister ship, "Queen Elizabeth," is launched into its waters. But the maintenance of the river is secured only by ceaseless dredging, involving the removal and transportation to sea, week in and week out, of 60,000 tons of spoil. Although small among rivers, the Clyde has the unique distinction of having made engineering history at the hands of those pioneers of our profession who saw and recognised the possibilities of the river, whose genius inspired the conception, and whose labours have made possible in the hands of their successors the conversion of a comparatively small river into a great national harbour, and the undoubted centre of the shipbuilding industry of the world.

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*Sea Defences at Admiralty Pier, Dover**

By JOHN WILLIAM SUTTON, Assoc.M.Inst.C.E.

Introduction

In recent years the condition of the masonry on the face at the inshore end of the Admiralty pier, Dover, has caused some concern owing to damage by sea-action. This damage, which is now confined to the west side of the pier, has mainly taken the form of loosened facing blocks, weighing on an average 3 tons each, being forced out of position by air and water pressure generated behind the face-work during rough seas. Hitherto, when the blocks have been recoverable they have been replaced and jointed, or alternatively the cavities formed have been shuttered and filled with mass concrete. Until 1912, air trapped in the heart of the pier during rough weather found a vent in the opposite face of the pier to the running swell, but from that date, when the widening of the Admiralty pier was completed, the west-side face-work has needed careful watching. In addition, the extension of the pier in a nearly easterly direction has increased the run of the sea along the wall, so that with any wind the sea conditions in this area are uncomfortable. The repair-methods employed as set out above gave good results, except that in some instances the trouble appeared to be transferred to a near or adjacent block, indicating that a void existed behind the face-work. In general, the dislodgments occurred at or just above the level of L.W.O.S.T.

Storm Damage

At the inner end of the pier the face-courses are in Bramley fall, with thinly-bedded blocks in course formation, the foundation course being 3-ft. 2-in. deep and the top course 1-ft. 3-in. deep. No other security than the bedding was provided, and the present general condition of the masonry is remarkable after 80 years' constant exposure to extremely bad conditions.

Following the very heavy storm of the 17th September, 1935, to which this work was fully exposed, an inspection disclosed that a settlement had taken place at the inshore end for a distance of 40-ft., commencing 20-ft. from the shore (L.W.O.S.T.) and extending seawards. Ten courses, 25-ft. in height, were affected, the settlement at approximately the centre being 2½-ins. A second and smaller settlement had also occurred at a point 100-ft. from the shore. Considerable blowing at the joints was set up when a swell ran along the pier, indicating the existence of hollows behind the face-work. At each local area a face-block had been forced away, and an examination in the cavities formed revealed that the backing to the face-work was suffering some displacement and that the chalk hearting of the pier was being broached by sea-action. An underwater inspection showed the cause of the settlement, which was erosion of the chalk bed in front of and underneath the foundation course, extending 300-ft. seaward; in some parts hollows 2-ft. deep had been formed. Fig. 1 is a cross section of the pier in the area under review, and shows the scouring of the sea-bed.

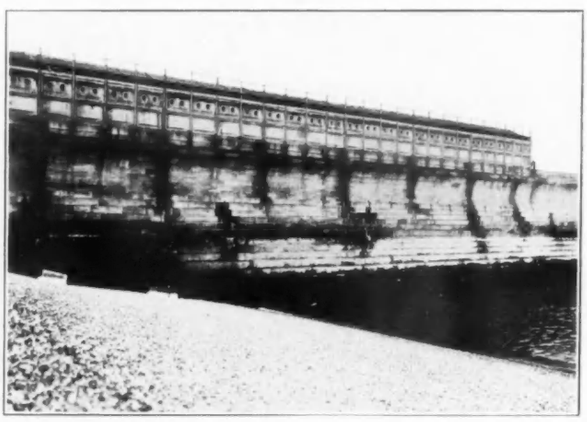
Repairs Necessary

Repair-work was divided into two sections:—

(1) The formation of an apron in the scoured sea-bed and the provision of protection to prevent further erosive action.

(2) Making good the masonry face of the pier, and filling as far as possible the voids behind the blocks.

The first part could be carried out only when sea-conditions were favourable, such conditions being only likely to occur for short periods during the summer. The second part could be carried on during fair or fine weather, and would have to be done mainly at low tide, except that the sealing of the underwater joints would have to be carried out by divers. Preparations were therefore made with a view to pressing forward with the work as soon as favourable conditions permitted. Actually from the time the settlement took place 10 months elapsed before continuous fine weather prevailed.



Repairs to Admiralty Pier

Method of Making Repairs

FORMATION OF APRON.—The eroded area under the bed course was first filled with concrete lumps, granite blocks and concrete in bags in sizes capable of being handled and placed under water by divers; the scoured trench in front of the foot of the wall was then filled with a double layer of concrete in bags, each weighing nearly 2 cwt., and placed as uniformly as possible, thus forming a toe-apron. A total of 40 tons of material was thus deposited.

Following this a pell-mell-block wave-breaker was formed for a length of 100-ft. at the shore end of the work to hold and protect the apron, and to provide additional defence for the face of the wall against sea-action. The need for this was emphasised when, during one day of bad weather shortly after the com-

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Sea Defences at Admiralty Pier, Dover—continued

mencement of the work, a 20-ft. length of the toe-apron close to the shore was torn away. For the pell-mell formation large dressed-granite blocks with an average weight of 10 tons were conveyed to the site and deposited. By reason of their cubic shape the blocks were roughly fitted together to prevent dispersal by rough seas until such time as shingle collected and provided additional bedding. The trend of the beach here is from west to east. Before the weather caused a suspension of operations sixty blocks had been placed. There is every indication that this formation has effectually provided a sound defence against under-toe scouring, for the unprotected apron from 100 to 300-ft. seaward is still intact. One addition of six blocks has been made to this pell-mell formation. Further additions are contemplated.

Before depositing these blocks all joints in the masonry below water were caulked, whilst above the level of L.W.O.S.T. all joints were sealed with Portland cement in both affected areas, in preparation for the second part of the work.

REPAIRS TO MASONRY FACE OF PIER.—It was decided to deal with this part of the work from the pier-parapet, as the risk of working from a barge was too great owing to possible sudden changes in the sea-conditions. The nearest point to the work was 40-ft. above it and about 120-ft. away. A platform and a 4-in. diameter feeding pipe were provided as shown in Figs. 2. Grout-holes, 5-in. in diameter, were drilled in the face-work, so arranged as to strike the joint between the block immediately below and the backing course. These are indicated in Figs. 2 at points A, B, C, and D.

The inshore area was dealt with first, the cavity being shuttered and fed with cement-grout, together with a small quantity of concrete when the work was nearing completion. The operation was carried out during one low-tide period. Following this, for three days during the morning low tides, holes A, B, and C were fed with cement-grout under gravity. Feed-holes A and B were both fed successfully, but feed-hole C soon became fully charged. In all 16 tons of material was used in this area. A similar procedure was adopted with the cavity and feed-hole D of the outer area, the work being completed in three low-tide periods. In this area 10 tons of material was used.

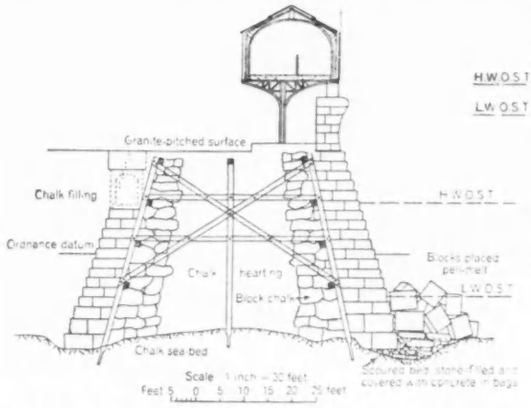


Fig. 1. Cross Section of Pier at Site of Inshore Settlement

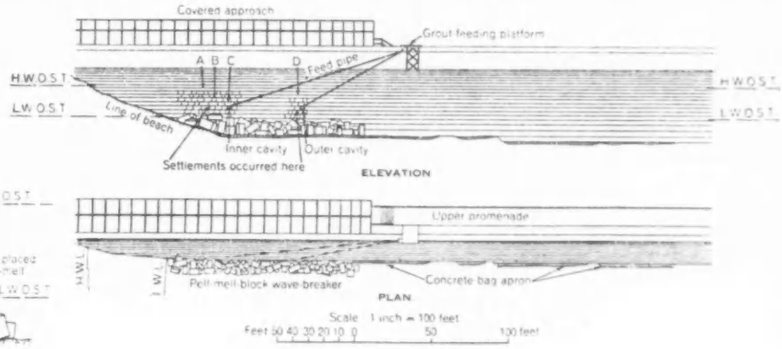


Fig. 2. Method of Repairing Masonry Face of Pier

No estimate could be formed of the quantity of cement-grout that would be required, owing to an almost complete lack of knowledge of the possible voids existing, and sufficient material for each working period was therefore transported to the site during the high-water periods. Fortunately, the weather remained good during the time that this work was being carried out; the operations covered two ranges of spring tides, and was carried out at the same time as the placing of the pell-mell-block sea-defence. Since the end of September, 1936, a few additional blocks have been placed and pointing at the joints made when quiet weather conditions have occurred.

Conclusion

Inspections indicate that there are no serious voids behind the Bramley-fall facing, as there is now no sign of blowing following sea-swell during bad weather, which is the chief symptom of this trouble. Several joints have been raked out to allow these examinations to be made, and in most cases the new cement-grout has been uncovered.

Bluff Harbour Board, New Zealand

Excerpts from Chairman's Annual Report for the Year ended 30th September, 1937

A summary of the Income and Expenditure Account is as follows:—

	£
Net Income	45,506
Ordinary Expenditure on Port operation	25,903
	19,603
Less Depreciation	8,465
Net profit, being credit balance on last year's working	11,138

Last year's credit was £8,930.

The Trade of the Port

The tonnage of cargo handled through the Port of Bluff for the 12 months ended 31/12/37 was:—

Imports 77,641. Exports 78,961—Total 156,602 tons.

The figures for the same period 1936 were:—

Imports 79,271. Exports 82,926—Total 162,197 tons.

This shows a decrease compared with the previous year of 1,630 tons imported and a decrease of 3,965 tons exported or a total cargo decrease of 5,595 tons.

The total value of exports from New Zealand for 12 months ended 31/12/37 was £66,713,397, easily the highest yet recorded, as against £56,751,940 for 1936, or an increased value of £9,961,439, equal to an increase of 18%.

The value of Bluff exports amounted to £3,664,458 or over 1-18th of the New Zealand total. The 1936 total was £3,116,052, so this year shows an increase of £548,406, or 17.6%.

The value of imports to New Zealand in 1937 amounted to £56,160,695 as against £44,258,886 in 1936, an increase of £11,901,803 or 27%. The 1937 total has been exceeded once only, in 1920, when, mainly owing to the fulfilment of orders delayed through war conditions, the abnormal total of £61,553,853 was reached. The next highest total apart from 1937 was £52,425,757 in 1925. The increase in 1937 was an all-round one.

Imports through the Port of Bluff amounted to £944,799, ranking fifth port in New Zealand, as compared with £697,177 in 1936.

The number of vessels which have worked cargo at Bluff for the year ended 30th September, 1937, was:—

Coastal 395. Overseas and Inter-colonial 120—Total 515.

The Report is signed by William A. Ott, Chairman.

Port Labour Problems

(concluded from page 319)

The measures described above have greatly improved the social position of the labourers, which, in turn, has promoted in a high degree the permanence of smooth conditions in the working of the port.

That the measures taken with a view to obtaining tranquility in the working of the port have been efficacious, may appear from the fact that, since the great strike of 1920, the work has not again been interrupted by strikes in any significant degree, and since 1925 the work has not been brought to a standstill on that account for a single day.

Regular employment in so far as the work presenting itself permitted of this, has trained the registered labourers to a high degree of usefulness, which, accompanied by the labour discipline, promoted by the S.V.Z., may be deemed to have had a specially beneficial influence on the productivity of the work. If at the commencement it was sometimes necessary to take corrective action against theft, drunkenness or improper conduct, at present this only occurs as an exception.

New Inland Waterway from Delaware River to Chesapeake Bay, Delaware and Maryland, U.S.A.

*The Chesapeake and Delaware Canal**

THE eastern coast of the United States is deeply indented by two great bays, the Delaware and the Chesapeake. The northern end of Chesapeake Bay bends to the eastward, and at one point, is only 20 miles distant from the westerly shore of Delaware Bay. Both sides of the peninsula between these bays are again indented by tributaries which, at their sources, are in some places only a few thousand yards apart.

The proximity of these headwaters early invited plans for connecting the two bays by a navigable channel so that commerce would not be compelled to follow the long sea route around, or make the portage across. In Johnson's History of Cecil County, Maryland, we read that "as early as 1680 one Augustus Hermen, Lord of Bohemia Manor, contemplated the construction of a canal to connect the Delaware and Chesapeake Bays."

Over 250 years later, the Army Engineers are now busy completing just such an inland waterway as was dreamed of by the Lord of Bohemia Manor.

Highway Bridge across Canal at Chesapeake City. Back Creek entrance to Canal in the distance.

By referring to the map below, it can be readily seen that water travel from Delaware Bay to Chesapeake Bay necessitated a trip of several hundred miles. In fact, the sea voyage between the cities of Philadelphia and Baltimore required a journey of more than four hundred miles, and so the construction of a canal connecting the upper reaches of the two bays meant a shortening of the trip by some three hundred miles.

Early Steps

History records that as early as 1764, a private survey was made for the purpose of connecting the two bays and another survey in 1769, the latter being interrupted by the Revolutionary War. No further activity is recorded until 1799, when the Legislature of Maryland passed an act incorporating the Chesapeake and Delaware Canal Company. Shortly thereafter a survey was undertaken to determine the best route for a canal. The States of Delaware and Pennsylvania also passed acts authorising the construction of such a waterway. The cost of the work was estimated at $2,250,000, and funds for its construction were ultimately obtained from: Federal Government, $450,000; State of Pennslyvania, $100,000; States of Maryland and Delaware, $50,000 and $25,000 respectively; and the remaining $1,625,000 by popular subscription.

The initially proposed route was one to connect Elk River with Christiana River, by means of fourteen locks with a feeder from Big Elk Creek to supply water for the main canal. After practically all the feeder canal had been dug, this route was abandoned due to lack of funds. Further studies were then made and a new location was adopted to connect Broad Creek with St. George's Creek, being substantially the route of the present Chesapeake and Delaware Canal.

The First Canal

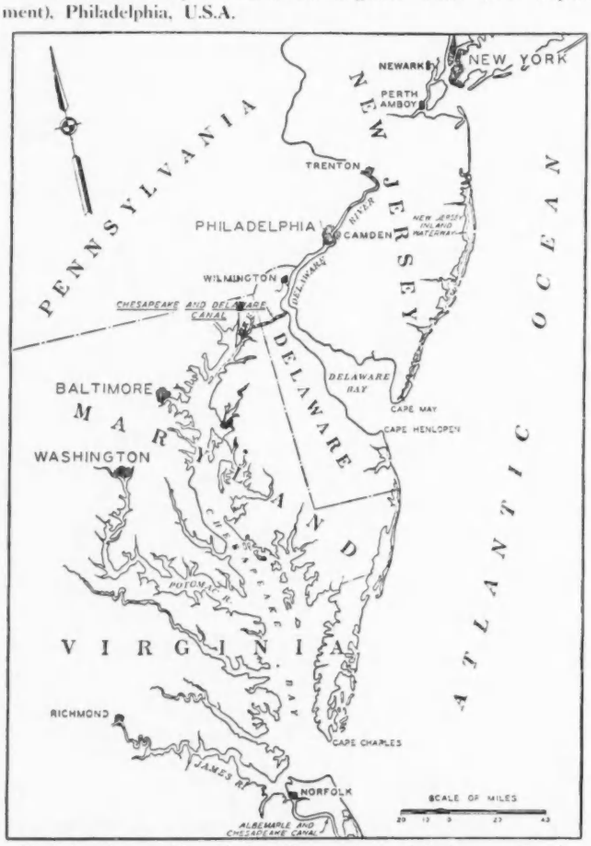
The original canal, constructed during the period 1824 to 1829, and officially opened October 17th, in the latter year, had its eastern entrance at Delaware City, Delaware, about 40 miles south of Philadelphia. Here a tide lock maintained a canal level of 7.6-ft. above mean low water in Delaware River. Thence the canal extended between banks partly natural and partly artificial, for a distance of 4.3 miles to the town of St. Georges, its level at some of the intermediate points being above that of adjacent marshes. With the rising ground in the vicinity of St. Georges, the canal level was raised 10-ft. by means of another lock, making the new level 17.6-ft. above mean low water in Delaware River. From this lock the canal continued for a further distance of 9.3 miles to Chesapeake City, Maryland, at which point a descent of 15-ft. was made by two locks to the level of Back Creek, an arm of Elk River and one of the upper branches of Chesapeake Bay. This old lock canal had a depth of 10-ft. and a bottom width of 36-ft. The locks were 96-ft. long, 22-ft. wide, and provided 8-ft. of water over the sills.

In 1851 a water wheel pumping unit was installed, superseding the old steam engine and pump which had been in operation since 1837. These pumping units were used to maintain the water level in the canal at the required height of 17.6-ft. The old wheel and pumping engine may be still seen at Chesapeake City.

During its 90 years of operation as a privately-owned toll canal, extensive improvements were made, including an increase in the size of the locks to a width of 24-ft. and a length of 220-ft., with 10-ft. depth over the sills.

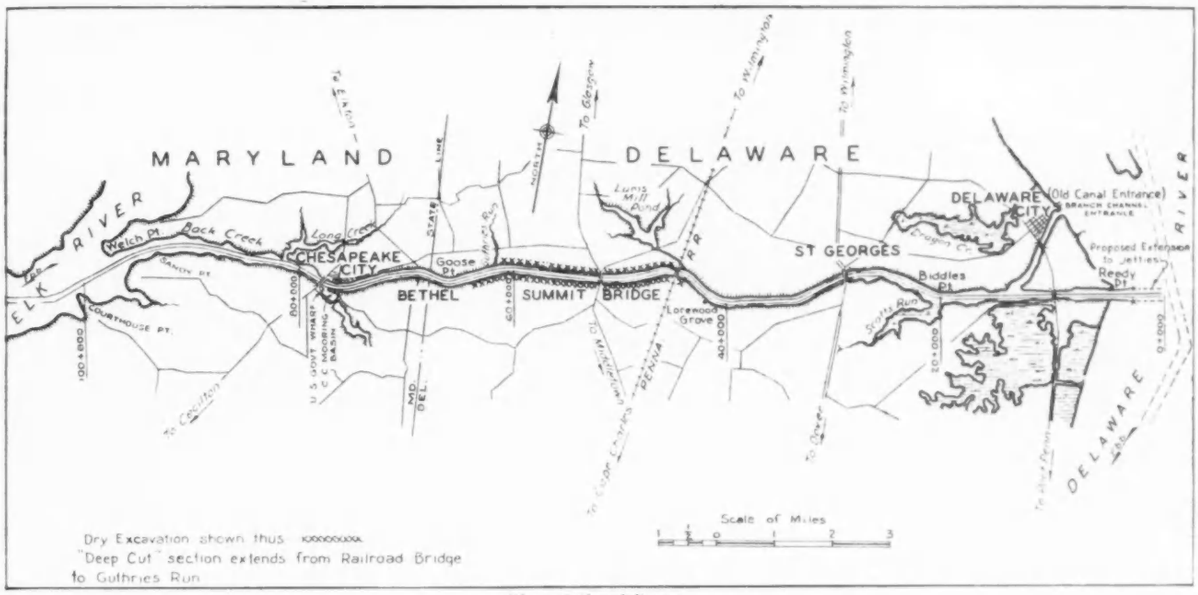
The original construction presented at the time quite an engineering problem. The excavation was performed by pick and shovel and the hauling by mules and carts. The section known as the "Deep Cut" presented the greatest difficulties,

* Communicated by United States Engineer Office (War Department), Philadelphia, U.S.A.



Map showing position of the Chesapeake and Delaware Canal

Chesapeake and Delaware Canal—continued



Plan of Canal Route

the excavation depth being as great as 75-ft. The excavated material was deposited on the banks adjacent to the work. This added weight caused the banks to slide in, requiring the removal of considerable excess earth.

Navigation through the waterway was mostly by mule power. A tow-path ran along the north side of the canal, over which the mule teams were driven to pull the barge or vessel through the canal.

Project for a Free Waterway

Such was the early history of the waterway. In 1871, interest developed for a deeper canal to permit the passage of larger vessels. In 1906, a Commission was appointed by the President of the United States to report on a route for a " free and open waterway to connect the Chesapeake and Delaware Bays." General Felix Agnus was chosen chairman of this Commission and in the following year the Commission submitted a favourable report, recommending the purchase and improvement of the waterway. Twelve years later, on August 13th, 1919, the Federal Government purchased the canal for $2,514,000. A project was adopted for a sea-level, toll-free canal 12-ft. deep at mean low water and 90-ft. bottom width at an estimated expenditure of $13,000,000.

The reconstruction of the canal was placed under the direction of the Corps of Engineers, with the District Engineer of Wilmington, Delaware, in immediate charge, under the supervision of the Division Engineer, North Atlantic Division, New York, N.Y.

In planning the work programme, consideration had to be given to carrying on the reconstruction with as little hindrance as possible to water traffic, which consisted of about 30 to 50 vessels per day, depending upon the time of year, and with the minimum of interruption to highway and railroad traffic crossing the canal over the various bridges.

In brief the work consisted of excavating a new rectified entrance channel about two miles south of the old entrance at Delaware City; removal of approximately 16,000,000 cubic yards of earth; building two protecting stone jetties at the eastern entrance; the construction of four highway bridges and one railroad bridge; and the removal of the old stone locks.

The canal was divided for excavation purposes into four sections, A, B, C and D. An initial contract was awarded for the removal of approximately 650,000 cubic yards in the dry, down to elevation plus 20, in Section " C," between the Inter State boundary and the Pennsylvanian Railroad. This material, excavated by a steam shovel, was handled by three trains of dump cars and was carried to the Lums Mill Pond area. This dry excavation work began June 27th, 1921, and was completed March 30th, 1922. In the light of the results of this contract, it was decided to employ dredging as the main method of removing the remaining material.

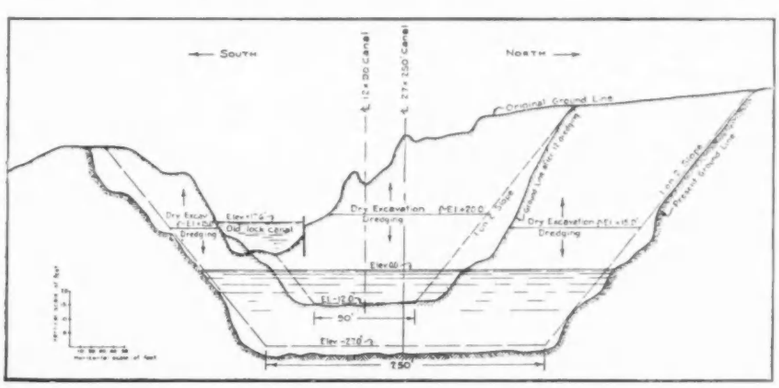
Dredging operations were commenced on December 10th, 1922, with a 26-in. hydraulic dredge, and were continued under various contracts until February 25th, 1927, when the water level in the canal was lowered. The waterway was completed to project dimensions on May 31st, 1927, at a total cost of $10,060,000.

A total of approximately 16,200,000 cubic yards of material was removed under the various dredging contracts. The plant used in the work consisted of seven large hydraulic dredges, two bucket dredges, two scoop dredges, a steam shovel, two dragline banking machines, and various tugs and miscellaneous attendant plant.

The problem of getting the large dredges into the canal, through locks only 24-ft. wide, was ingeniously solved by constructing cofferdams of steel sheet piling in two sides of the saving basin adjacent to the canal and Chesapeake City. (The " saving basin " was a pool provided alongside of the lock, into which the upper half of the prism of water in the full lock could be drawn in emptying the lock, and there preserved for use in filling the lower half when the lock was next filled). By removing one of these cofferdams, access to the basin was established at tide level with Back Creek. The dredge was moved into the basin, the cofferdam restored, and the water in the basin was then raised to canal level. Access to the canal was then gained by removing the other cofferdam. Altogether, six dredges were taken in and out of the canal in this manner.

The deepest excavation was through the summit divide, continuing to be known as the " Deep Cut," where the general land elevation was 80 to 85-ft. above sea-level. The spoil in this area was deposited in specially prepared basins adjacent to the work, involving lifts of 80 to 95-ft. Considerable excess dredging was required in this section because of bank slides.

The construction of suitable bridges to replace the old wooden swing bridges, and to meet future enlargements of the canal required careful investigation and planning. The vertical lift type of bridge was selected for all locations along the main canal, on the basis of lowest first cost and maintenance. Because of the short distance between the old Chesapeake City and Bethel bridges, it was decided to eliminate the latter crossing. All the bridges were designed to have an open vertical clearance of 140-ft. above low water and a horizontal clearance of 175-ft. between fenders, excepting Chesapeake



Typical Sections in " Deep Cut "

Chesapeake and Delaware Canal—continued

City bridge, which was designed with a longer lift span, allowing a horizontal clearance of 240-ft.

The bridge pier bases were carried down to elevation minus 40. The abutments (except at Summit, where the abutments are really buried piers) are of conventional type with wing wall parallel to the roadway and supported on piling. Operation of the bridges was originally by direct current from storage batteries which were charged by motor generators using commercial alternating current. In 1931 the operating mechanism was changed to use alternating current directly from local power lines. Emergency operation is taken care of by a gasoline engine, which can raise the span by direct connection through a belt to the gear train. All bridges are of the through truss type and were designed to accommodate highway traffic, then foreseen, for future years and to carry safety loads incidental to troop movements.

Entrance Jetties

In order to protect the new canal entrance from shoaling at Reedy Point, two jetties of rubble-mound type were constructed upon brush mattresses. Since brush mattress construction was not well known among contractors in the locality, it was decided to construct the jetties by hired labour, the brush and stone being purchased by contract. The two jetties, each approximately 1,350-ft. long, extended from the shore line into a river depth of about 15-ft. They were spaced 500-ft. apart at the shore end and about 800-ft. apart at the outer end. The jetty tops, 10-ft. wide, were built to a height of 10-ft. above low water. The brush mattresses, which extended the entire length of the jetties, were 2-ft. thick and 60 to 80-ft. wide. They were sunk as built with a 2-ft. layer of small stone, upon which the larger stones were deposited, forming the body of the jetty. The large stone varied in size from " one man " stone to 10-ton blocks. These jetties were completed April 1st, 1929, at a cost of approximately $350,000.

Later Developments

Shortly after the lock canal had been reconstructed as a sea-level waterway, interest developed for a wider and deeper channel. A report in 1933 by the Board of Engineers for Rivers and Harbours recommended that the project for the Inland Waterway from Delaware to Chesapeake Bay be modified to provide for a channel 25-ft. deep and 250-ft. wide from Delaware River to Elk River, thence 400-ft. wide down Elk River and Chesapeake Bay to deep water at or near Pooles Island.

The existing project, as adopted in 1935, provided for a ship canal with the same dimensions as specified in the 1933 report, except that a depth of 27-ft. was authorised. Up to that time the canal limits had been between the Delaware and Elk Rivers, but the new project added approximately 26 miles to its length, necessitating the dredging of approach channels 400-ft. wide in Chesapeake Bay and Elk River to the old canal entrance at the mouth of Back Creek. As the portion of the new project below Back Creek provided for the improvement of waterways under the jurisdiction of the Baltimore Engineer District, it was decided to leave such portion of the project under the jurisdiction of that office.

27-ft. by 250-ft. Channel Dredging, Looking East. Old 12-ft. by 90-ft. Channel in Foreground, new Channel-cut in Background. Banks on left were excavated in the dry

Under the Emergency Relief Appropriation Act of 1935, funds in the amount of $5,107,000 were allotted to initiate the enlargement work. Since the primary purpose of the Act was to provide employment for persons on relief, the specifications contained rigid provisions that contractors should secure 90% of their workers from relief rolls. Work under the revised project required removal by dredging of approximately 35,000,000 cu. yds. of material, of which 2,500,000 developed from shoaling in sections previously completed to 27-ft. The various contractors' powerful pipeline dredgers " Baltimore," " General," " Orion " and " Ventnor " pumped out material at the combined rate of 1,000,000 cu. yds. per month. The dredger "Baltimore." built at a reported cost of about 1,000,000 dollars, is one of the most powerful and probably the most modernly equipped pipeline dredger afloat.

In order to minimize the hazard of major slides in the " Deep Cut " section, it was decided to remove the over-burden by excavation in the dry, down to the plane of 15-ft. above mean low water. All material so removed was deposited behind a line representing the intersection with the ground surface of a 1 on 5 slope, measured from the widened channel edge. Three dry-excavation contracts were awarded for this work, which was prosecuted with an interesting variety of equipment, including steam shovels, drag-lines, elevating graders, powerful Diesel tractors, Le Tourneau scrapers, caterpillar wagons, Euclid carry-alls and large dump trucks.

Geographically near these contracts, but in method as far apart as the poles, another operation was carried on which resembled a busy anthill. Within two hundred yards of the modern machinery job, twelve hundred men were building banks for future disposal areas by the time-honoured method of pick, shovel and wheelbarrow. Near St. Georges, a thousand more men were engaged in similar work. These were all men taken from the relief rolls of Baltimore and Wilmington, who worked at the so-called "security wage," 140 hours per month, being transported daily from their homes to the job by trains and trucks furnished by the United States. While the primary purpose of this work was to provide employment for the workers, the banks they constructed could be eventually utilised for the retaining of spoil from hydraulic dredging.

Work under the project has required the acquisition of additional land in the States of Delaware and Maryland, through condemnation proceedings in the United States District Court for the Districts of Delaware and Maryland. When the project is completed the United States will own approximately 6,840 acres of land along the Chesapeake and Delaware Canal.

Incident to the work of enlarging the canal prism was the removal of the old canal locks, one at St. Georges and one at Chesapeake

Old Canal Lock at St. Georges, Del. Highway Bridge in Foreground.

Chesapeake and Delaware Canal—continued

City. The lock at St. Georges was removed by Government plant and hired labour; the one at Chesapeake City was removed by contract.

In order to prevent constriction of the channel prism at the bridges with resulting increased currents, it was decided to excavate the full prism at these places. This necessitated removing the abutments of Reedy Point and St. Georges bridges and constructing shoreward new abutments, to and upon which additional length of shore spans had to be provided. The piers of St. Georges and Summit Bridges were reinforced by driving steel pipe batter piles around each pier. These piles were later filled with concrete and the tops imbedded in a concrete collar, fastened around the top of the existing pier. The piers on the railroad bridge were reinforced by a wall of steel sheet piling, driven vertically around the pier, and the space between the existing pier and the sheet piling filled with concrete.

Completion of the project has involved the partial reconstruction of a State highway near Lums Pond incident to use of that area for disposal of dredged material, construction of bridge pier fenders and emergency mooring dolphins, extension of the jetties at the Delaware River entrance, dredging of an anchorage basin at Chesapeake City, partial revetment of the canal banks, and drainage and grading of the spoil areas.

In spite of many construction difficulties encountered, work on this project has progressed more rapidly than was originally planned. An adequate channel had to be maintained for existing canal traffic, so that steamship companies could maintain their schedules. Moreover, highway traffic had to be maintained over the bridges, even during alteration operations on those structures.

Lock Canal, looking East. Towpath appears along North Bank

The greatest difficulties were encountered in the Deep Cut area. Even when the old lock canal bottom was 5-ft. above the present water level, the orginal canal company suffered heavy losses from slides. During the Federal conversion into a sea-level canal there developed more slides. Although the material above the 15-ft. plane had been removed in the dry down to a 1 on 2 slope, considerable portions of the banks slid into the channel before project dimensions could be obtained. In other sections, which for a time appeared to be stable, slides have occurred that have endangered the open channel. Approximately 700,000 cu. yds. of such excess material has already been removed, and this amount may be doubled before the banks are stabilised. The location of a slide can hardly be predicted, nor can the quantity of material involved be computed in advance. The most economical way of treating the slide section still appears to be the removal of the material after it starts moving into the channel. In spite of these slides and other construction difficulties, the work has progressed so that at the present time the only remaining work required to permit opening the canal to deep-draft ships is the removal of shoals west of Chesapeake City and each of St Georges, under existing contracts, and the completion of the bridge fender systems.

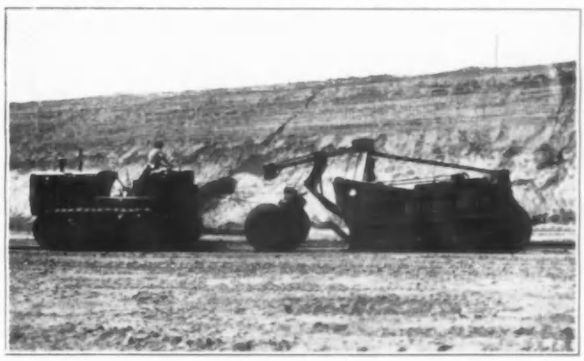
Tidal Action

When the canal was originally changed to a sea-level waterway it was subjected for the first time to tidal action. The eastern end of the canal continues under the tidal influence of Delaware River and Bay, while the western end is goverened by tides in Elk River and Chesapeake Bay. As a result, there is a marked difference in the time of high and low tides at the two ends of the canal. High water in Delaware River occurs about two hours later than in Elk River. The normal current velocity varies from two to four miles per hour. Studies are in progress to verify the predictions of tides and currents.

Traffic Control

The present traffic control system of the canal consists of a central dispatching office at Chesapeake City, where chief dispatcher supervision is provided 24 hours a day, keeping in touch with the bridges by telephone, and by radiophone with the two patrol boats, stationed at either end of the canal. As vessels enter and leave the canal they are promptly reported to the dispatcher. Moreover, as each vessel transits the canal its progress is reported when it passes each bridge. In this manner, the dispatcher knows at all times just how many boats are in the canal, their approximate location, and when they leave.

Traffic lights are being installed at Reedy Point, the Delaware entrance to the canal, and in Back Creek, the Maryland entrance to the canal, so that the movement of vessels desiring



Contrasts in Excavation Methods used in Reconstructing the Canal

to enter the canal may be controlled. The dispatcher system includes the two afore-mentioned patrol boats, on 24-hour service. The crews of these boats gather commercial statistics, investigate delays to traffic, and perform general inspection work, including assistance to the U.S. Lighthouse Service by seeing that navigation lights are burning and marker buoys are in place.

The U.S. Lighthouse Service has co-operated helpfully with the War Department in placing and maintaining necessary lights and buoys in the canal and its approaches.

Completion of all the major items in this improvement, excepting the construction of extensions to the present jetties, has just been accomplished (May, 1938). On account of recurring shoals in "Deep Cut" Section, the full project depth and width of channel will not be available as early as was anticipated.

Chesapeake and Delaware Canal— continued

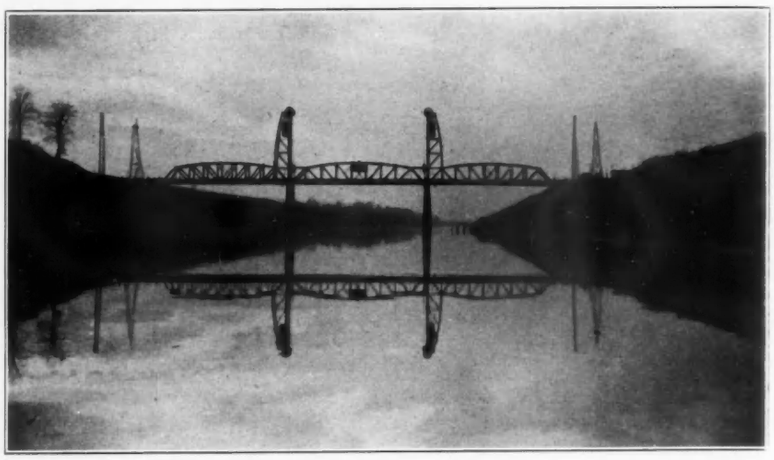
Approach Channel

The portion of the canal from the mouth of Back Creek, extending down Elk River and Chesapeake Bay to a point south-east of Pooles Island, a distance of about 27 miles, is under the jurisdiction of the District Engineer, U.S. Engineer Office, Baltimore, Maryland, and the supervision of the Division Engineer, South Atlantic Division, Richmond, Virginia.

Funds for this approach channel to the canal in the amount of $2,180,000 were alotted from various War Department appropriation Acts under dates of July 23rd, 1936, January 22nd, 1937, July 1st, 1937, July 21st, 1937, and January 28th, 1938.

Dredging was started July 21st, 1936, by United States hopper dredger " Navesink." The United States hopper dredgers "Absecon," "Atlantic" and " Delaware " commenced dredging on August 21st, September 4th, and September 17th, 1936, respectively. The dredgers "Absecon," "Atlantic" and " Navesink " stopped dredging on October 9th, 1936, January 12th, 1938, and January 14th, 1938, respectively. A total of 23,298,079 cu. yds. of material (bin measure) had been removed to February 28th, 1938, by the four dredgers. Some of the dredged material was deposited in areas adjacent to the work, but such areas being few and of insufficient capacity, it became necessary to provide an area ashore upon which the dredged material might be placed. The most suitable area for this purpose was that at Pearce Creek on the east side of Elk River, opposit Turkey Point, and a marsh area bounding the creek. This area, comprising 996.93 acres, was acquired in fee simple by the United States through condemnation proceedings.

Preparation for use of the area involved fencing the boundary of U.S. property and installation of suitable gates, construction of 3¼ miles of retaining dykes amounting to approximately 150,000 cu. yds. of earth fill, excavation of approximately 75,000 cu. yds. of earth for drainage ditches, the relocation of roads, replacement of a highway bridge, construction of three timber spillways and an auxiliary spillway protected by riprap paving, the dredging of a rehandling basin with a channel of approach thereto and protection of the basin by the construction of a steel sheet pile breakwater, 1,000-ft. long. The material excavated from the rehandling basin and approach channel was pumped ashore to form a hydraulic dyke, about 21-ft. high along Elk River, and amounted to about 1,520,000 cu. yds. place measure.



Present Bridge across Canal at Summit Bridge, Del.

Material dumped, by the self-propelled hopper dredgers into the rehandling basin to the amount of approximately 9,000,000 cu. yds., bin measure, had been pumped ashore by a 26-in. pipe-line dredge by January, 1938. This material has formed a hydraulic fill between the afore-mentioned dykes.

The dredging has been completed in this portion of the canal.

The channel between Delaware River and Pooles Island has been dredged to Chesapeake and Delaware Canal datum, which corresponds to mean low water in Delaware River at Reedy Point. The normal range of tide is about 5.5-ft. at the Delaware River end of the canal and about 2-ft. at the Elk River end, thence the range decreases to about 1.5 at Pooles Island in the Chesapeake Bay. In the Elk River and Chesapeake Bay section of the canal there is a mean low-water depth of approximately 2.5-ft. more than project depth.

The deepening and widening of the canal channel from Delaware River to Elk River has been prosecuted by the District Engineer, U.S. Engineer Office, Philadelphia, Pa., under the direction of the Division Engineer, North Atlantic Division, New York City.

Proposed Improvements at the Port of Baltimore

At a recent hearing before Colonel W. A. Johnson, United States District Engineer, the following programme of improvements at the Port of Baltimore was put forward for consideration and approval:—

1. Widening of the present Baltimore main ship channels from Sandy Point to Fort McHenry, from 600 to 1,000-ft. An increase in channel width is stated to be desirable in the interests of safe navigation and in order to provide more adequate accommodation for the increasing maritime business of the port.

2. Deepening of the main approach channels to the port, including York Spit, from 37 to 40-ft.; deepening from 35-ft. to 38-40-ft. of the main Baltimore ship channels above Sparrows Point, with similar increased depths in the anchorages and the Curtis Bay and Port Covington channels. The following reasons are given:—Vessel " squat " of several feet, when ships are under way, reduces the amount of water under keels; water levels in the channels occasionally are depressed from 2 to 4½-ft. by heavy winds; several feet of water are required under ships' keels for safe navigation; water in the Patapsco River is not completely saline and vessels consequently need more depth of water.

3. Dredging of the present Riverview Anchorage from 35 to 38-40-ft.; construction of new anchorage facilities, 38-40-ft. deep, 1,500-ft. wide and 4,500-ft. long, immediately adjoining the lower end of the present Riverview Anchorage and adjacent to the local Quarantine Station. This would form Unit No. 2 of the Riverview Anchorage, as proposed several years ago, and would offer a combined main port anchorage of 1,500-ft. by 9,000-ft. Additional anchorage space is needed to accommodate the overflow of the Riverview Anchorage. Clearance through quarantine would thereby be expedited and the lower end would provide facilities for the transfer of dangerous cargo.

4. Construction of a new channel to the upper Chesapeake Bay and the Chesapeake and Delaware Ship Canal by continuing the present Brewerton Channel, dredged to a depth of 27-29-ft. and a width of 400-ft. This would reduce the present round-about vessel course of 17½ miles to 5½ miles, a saving of 12 miles per trip and approximately 1½ hours to deep-draft vessels using the Chesapeake and Delaware Ship Canal on Baltimore voyages.

5. A new project providing for the extension in the Curtis Creek area of a deep-draft channel, probably 33-ft. deep, 200-ft. wide, and its future maintenance by the Federal Government. The extension of a channel 30-ft. deep and 100-ft. wide from Ferry Bar into Spring Gardens. These improvements would benefit various industrial interests in these sections.

Reconstruction and Improvement of La Guaira Harbour Works

It is announced that the Ministry of Public Works in the United States of Venezuela will be shortly asking for tenders from responsible contractors for the improvement of the harbour at La Guaira. The first part of the work comprises:—

(1) Extending the existing north breakwater about 500 metres in water up to 15 metres deep, and containing about 300,000 cubic metres of rock in rubble mound.
(2) A West breakwater from the South shore into about 12 metres of water, about 600 metres long and containing about 250,000 cubic metres of rock in rubble mound.
(3) Reinforced concrete wharf 270 metres long by 8.50 metres wide on the East side of West breakwater.
(4) Reinforced concrete piled wharf 850 metres long and 25 metres wide on South side of harbour.
(5) Shallow water basins enclosed by sheet piling.
(6) Dredging harbour to 10 metres depth and pumping dredged material, about 600,000 cubic metres, behind piled wharf on South side as reclamation.
(7) Incidental work in connection with above six items.

Sketch plan and type cross sections of the main work are to be seen at the offices of the Ministry of Public Works and of the Venezuelan Consulates abroad. Firms interested are invited to send their names and qualifications to the Ministry of Public Works, Caracas.

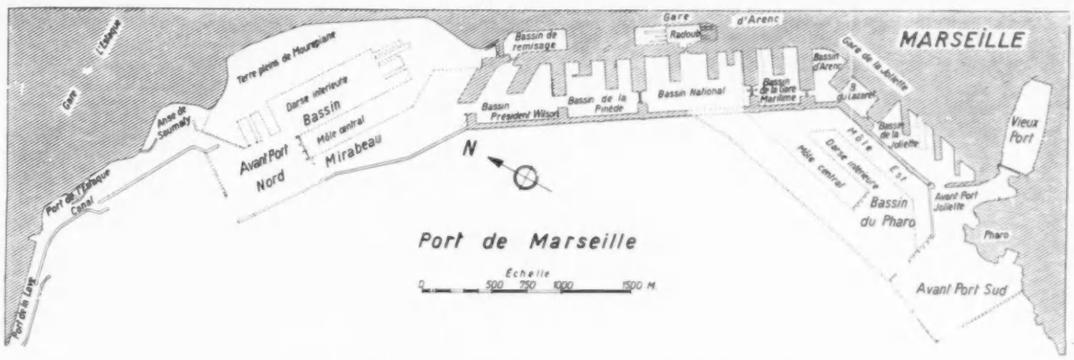


Fig. 1. Port of Marseilles. Present Layout and proposed Future Extensions

The Port of Marseilles*

Remodelling the Joliette Basin†

By M. P. PELTIER

L'Ingenieur des Ponts et Chaussees. Directeur des Services Techniques de la Chambre de Commerce, Marseilles

I.—GENERAL

FOR nearly 2,000 years the Port of Marseilles was restricted to the sheltered and fairly spacious inlet which is now called the Old Harbour. At a moderate cost, both in capital expenditure and in upkeep, this basin enabled the port to cope with traffic which even a hundred years ago already exceeded one million tons (nett register) per annum, and which put Marseilles—whether on comparison of tonnage of shipping or value of goods—in the fifth place among the seaports of the world, ranking next after London, Liverpool, New York and Hamburg. But, about 1840, the congestion in the harbour was so great and the growth of traffic so rapid (40 per cent. from 1830 to 1840) that enlargement became necessary. It was consequently decided (by Act of 5th August, 1844) to form an auxiliary basin to the North of the Old Basin. This auxiliary basin, named the Joliette Basin, being soon found inadequate, led to the formation of a succession of basins further to the North (see Fig. 1), of which the last to be added, the President Wilson Basin, has been in full service for several years.

This dock system is ultimately to be completed, to keep pace with the demands of traffic, by the Mirabeau Basin, now in course of construction, and later on by the Pharo Basin.

These extensive improvements at Marseilles have, moreover, been supplemented by the formation of a ship canal between the Port of Marseilles and the Etang (or Lake) of Berre, and the installation on the lake of a large marine establishment, mainly of industrial character.

These considerable extensions have enabled Marseilles to cope with an increase in navigational movement, which can be traced in the figures below:—

1847—2,932,005 n.r.t., in and out added.
1913—21,208,575 ,, ,, ,,
1936—32,995,068 ,, ,, ,,

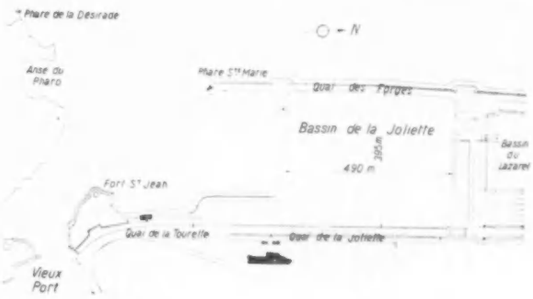


Fig. 2. Joliette Basin as it was (1844 to 1952)

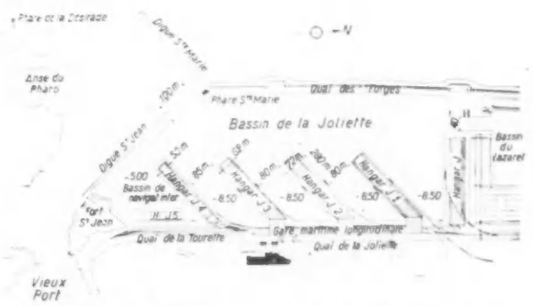


Fig. 3. Joliette Basin as it will be on completion of the works in progress

* See also previous articles in "The Dock and Harbour Authority" for May 1928, April 1935, and August 1937.

†Reprinted from La Technique des Travaux, June, 1937.

Fig. 4. The Joliette Basin and the Port of Marseilles, Summer, 1936. In the foreground, Catalans Bay, the Pharo Peninsula and the School of Medicine. On the right, the passage leading to the Old Harbour, with the Transporter Bridge. In centre, the Joliette Basin and, extending to the left, the other Basins of the Port

Port of Marseilles—continued

Fig. 5. Joliette Basin as it was (1844 to 1932). View taken from the Transporter Bridge. Note the ships moored stern-on at right angles to the quays

During the last year (1936) the Port of Marseilles, classed as the premier port of France, has received or despatched 16,833 vessels, 9,251,319 tons of goods and 714,578 passengers.

The continual growth of maritime movement and the needs of navigation necessitated not only the creation of new facilities but also the improvement or the reconditioning of old ones. The renewal programme, drawn up by the State and by the Marseilles Chamber of Commerce, comprises in particular the remodelling of the Joliette Basin. The works connected therewith are those now to be described.

II.—GENERAL PROGRAMME FOR REMODELLING THE JOLIETTE BASIN

At first the Joliette Basin (see Figs. 2 and 5) only had quays on its four sides. The length of quayage thus provided being much too short in regard to the number of vessels to be accommodated, the practice was followed (see Fig. 5) of mooring the vessels stern-on to the quay, which involved costly handling of goods by means of lighters, made it impossible to employ mechanical handling plant, and prevented the landing and embarkation of passengers in comfortable conditions. The comparison of Figs. 2 and 3 will give an idea of the magnitude of the alterations which were begun in 1932 to remedy these drawbacks. These works comprise:—

1. The construction of two solid breakwaters, projecting respectively from the St. John Fort and St. Mary Lighthouse.
2. The enlargement of the basin southwards, by demolition of the Major traverse, and general deepening to −8.50 metres, which is practically sufficient for vessels trading with North Africa and Corsica.
3. The construction of three oblique jetties (J.1 to J. 3), accessible on both sides to sea-going vessels, and of a fourth jetty accessible on its North side to sea-going vessels, and on its South side to small coasters and inland navigation craft.
4. The formation of an inland navigation dock on the South of Jetty No. 4.
5. The reconstruction and widening of the North quay of the basin.
6. The widening to 40 metres of the Passage leading from the Joliette Basin to the Northern basins.
7. The general equipment of the Basin with railway lines for passengers and goods, the erection of sheds and the provision of cranes, gangways and internal equipment of sheds.
8. Construction of a large terminal marine passenger station, providing for the arrival and departure of boat-trains; also for the accommodation and circulation of taxis and private cars for passengers.

When these works are finished, which will be during 1938, the Joliette Basin will include:—

16 liner berths.

More than 500 metres of quayage for inland craft and coasters.

More than 110,000 sq. metres of covered areas (sheds and station) for the storage of goods and for the circulation or standing of road vehicles, boat-trains and passengers.

56 general cargo cranes of various capacities, and 16 passenger gangways.

The Joliette Basin will thus be fitted to serve, under the best modern conditions, the liner traffic to and from Algeria, Tunisia and Corsica, which represents the transport of 400,000 passengers in a year and nearly a million tons of goods.

In the planning and execution of these works some special local obstacles were encountered which it may be useful to mention. In the first place, it was required as indispensable that the works should be carried out with the least possible interference with the commercial traffic, which could not be transferred elsewhere in the port because —for one reason—of the congestion in other basins, and for another thing because of the established course of trade.

It was necessary, moreover, to provide, notwithstanding the narrowness of the basin, 16 mooring berths for ships of 100 to 150 metres in length.

Finally, the very special nature of the traffic to and from North Africa and Corsica imposed unusual conditions arising on the one hand from the conjunction of goods traffic and passenger traffic, both of consid-

Fig. 6. Shed J 4. Setting Pedestals in place. On left, top of a Pedestal already placed

Port of Marseilles

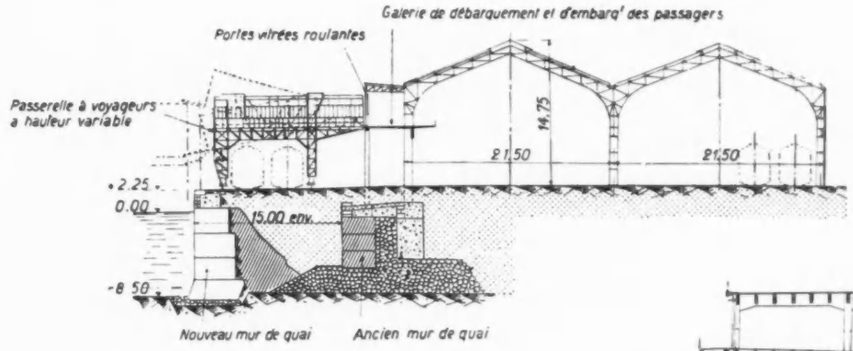


Fig. 7.

Shed J. Type Cross Section.

Old Shed reconditioned and extended by a Passenger Gangway at first floor level. New Quay Wall built 15 m. in front of the Old Wall

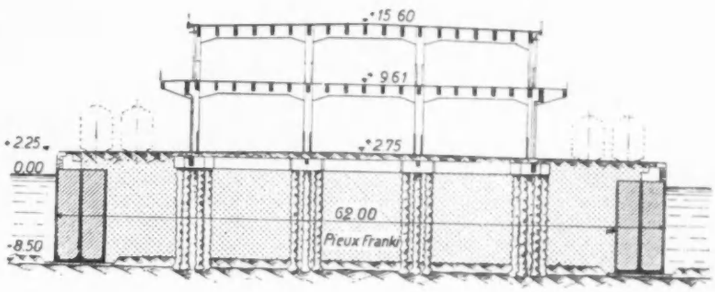


Fig. 8. Shed J. 5. Type Cross Section and part Plan of Foundations

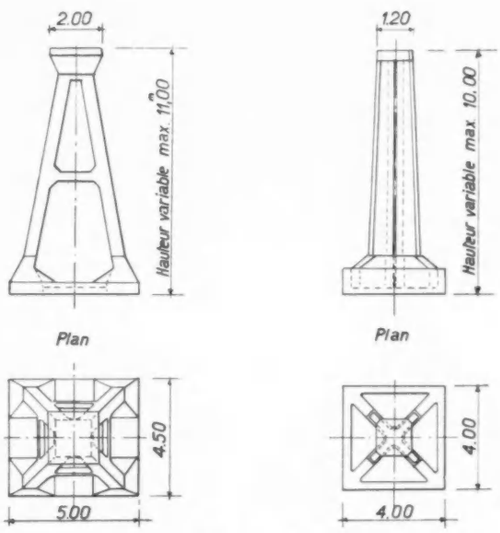


Fig. 9. Foundation Pedestals for Sheds J 1 and J 4.

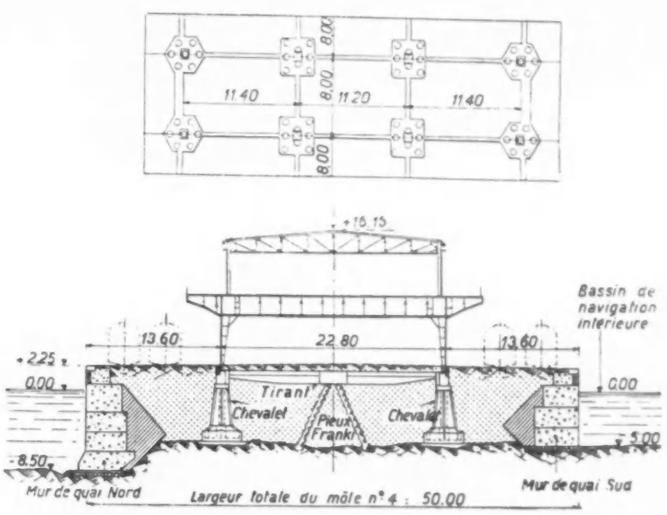


Fig. 10. Shed J 4. Type Cross Section. Cranes and Gangways as in Fig. 12

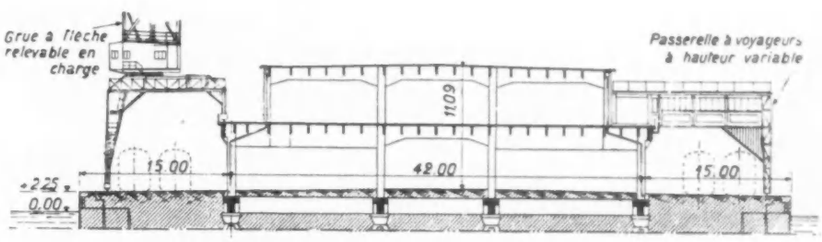


Fig. 11. Shed J 2. Type Cross Section. Cranes and Foundations as in Fig. 12

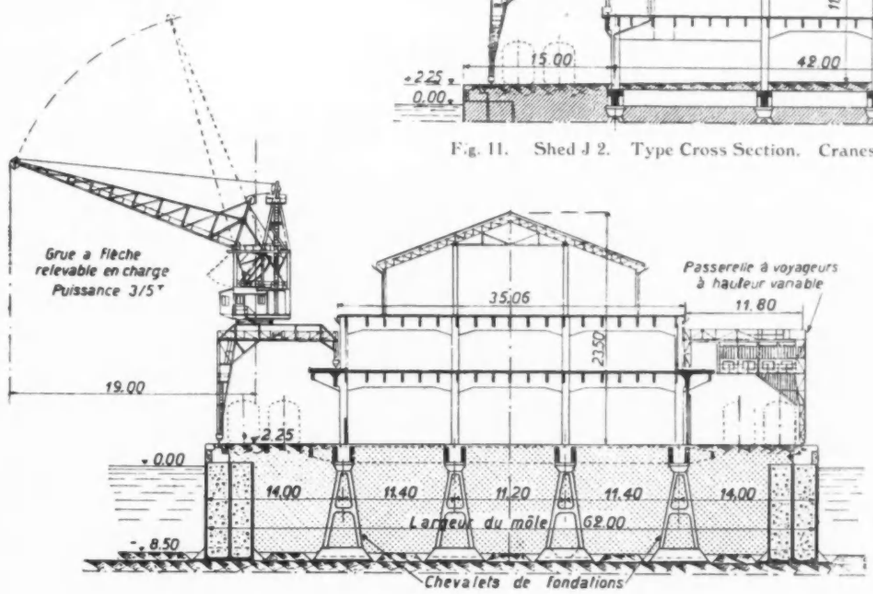


Fig. 12. Shed J 1. Type Cross Section. Luffing Crane, 3-5 tons lift. Gangway of adjustable height. Width of Jetty 62 m Foundation Pedestals.

Port of Marseilles—continued

Fig. 13. Shed J 4. The Shed Frames are nearly all in place, also the Ground Beams. On the right, at water level, the tops of blocks of the Quay Wall under construction

erable volume, and on the other hand, from the particular character of the goods traffic.

The goods passing through the Joliette Basin are, in fact, of a very miscellaneous character, and often in very small parcels: some of them, such as early vegetable produce, entailing particular requirements in regard especially to the space needed for sorting and to speed of delivery. Moreover, these goods give rise to very intensive road lorry activity.

The passenger traffic also involves special requirements by reason of the necessity, in connection with the North African lines, of embarking and landing simultaneously by different routes, passengers of both first and second class.

Another factor of difficulty is that, unlike the conditions at distinctively passenger ports, where the number of liners arriving together is always very small, it frequently happens at the Joliette that attention must be given to a comparatively large number of arrivals or departures at the same time.

Also, as the passengers taking the boat-trains only represent a fraction of the total number, it becomes necessary to provide separate roads for taxis and private cars distinct from those travelled by goods lorries and vans.

These various problems have been solved by the provision, for the 16 berths, of a single passenger station, in which the ground floor is for the service of boat-trains, the first and second floors for passenger road conveyances; the movement of the passengers themselves between the ships and the marine station being effected on the first floor of the sheds connected with the station in such a way that the passengers are not at any time mixed up with the handling of goods.

We will not deal fully with the arrangements of the marine station, whose construction has been in hand during the past year and may be described later. Nor need we in this article dwell upon the methods of construction of the breakwaters and quay walls, these works being of the type familiar at Marseilles and already frequently described. We need only remark, in regard to the quay walls, that these are constructed either of blocks built up is courses (Figs. 7 and 10) or of reinforced concrete caissons floated out and sunk in place (Figs. 8 and 12): what we will describe are the sheds, their internal equipment, the cranes and the passenger gangways.

Fig. 14. Shed J 4. View from the South

III.—THE SHEDS: CONSTRUCTION

Figs. 7 and 10 show the general characteristics in cross-section of the five principal sheds at the Joliette Basin: J. and J.1 to J.4. Three of these are either built (J.1 and J.3) or intended to be built (J.2) of reinforced concrete. The other two (J. and J.4) are steel-framed structures. Shed J, moreover, is an old one in regard to which the works undertaken comprise only a general reconditioning and the addition, at first-floor level, on the side fronting the quay, of a glazed gallery for embarking and landing passengers, connected with the ships by travelling gangways. These works are of no particular interest and we will limit ourselves to speaking of the other four sheds.

(a) Character of Soil

At the Joliette Basin the underlying strata are of rather varied character. The solid bearing bed is composed either of virgin limestone or of compact clay or of conglomerate. The bearing bed at the site of the works is generally found at a level varying between −5 and −14 in relation to the zero of the port, which corresponds approximately with the level of "lowest low-water." It is covered either by a simple blanket of mud or sand, or by soft fissured rock, or in places by alternating beds of gravelly sand and of soft clay.

(b) Foundation of Shed J.3 on Piles cast *in situ*

The moles or jetties are formed by filling within an enclosure made by constructing the quay walls first. Then the standard procedure previously employed at Marseilles in the northern parts of the port comprised the provision of foundations for the sheds by groups of *in-situ* piles cast in the filling. This method has been followed for Shed J.3 (see Fig. 8), which is founded on 910 Franki piles cast *in situ*. The main features of these piles are as under, viz.:—

Bearing power: 80 tons per pile: piles tested to 120 tons.
Reinforcement: 5 bars of 20 mm.: spirals of 8 mm. at 15 cm. pitch.
Concrete mix: 300 kilos of cement per cu. metre of finished work.

The Franki system was also employed for the raking piles of Shed J.4, which will be mentioned later.

(c) Foundation of Sheds J.1, and J. 4 on Pedestals.

We have already remarked upon the necessity of remodelling the Joliette Basin without interruption of trade and with the minimum of inconvenience to those concerned in it. In consequence, it was impossible to deal with all the jetties at once, but on the contrary, the work had to be done in successive stages, each stage being only undertaken after the quays and sheds of the previous stage were completed and put into service at least partially. In these circumstances it was important, if excessive total time of execution was to be avoided, to be able to put quays into service as soon as they were completed. Hence it was necessary to adopt

Port of Marseilles—continued

for the sheds (excepting Shed J.3, where piles could be adopted without appreciable delay) a process permitting them to be constructed simultaneously with the quay walls and without waiting for the filling. Now founding upon piles does not satisfy these conditions, since the driving of them cannot be commenced until some time after deposit of the filling, which in turn cannot be commenced until after completion of the quay walls. It is for this reason that M. Gourret, who was the author's predecessor as Engineer and is now Manager of the port, was led to conceive and bring into operation a method of founding upon pedestals, which we will proceed to describe.

The pedestals employed are all of reinforced concrete, and of two types (see Fig. 9). Those for Sheds J.1 and J.2 are composed of four raking struts, firmly braced together, converging at the top in a concrete head and connected at the foot by a stiff slab which spreads the pressure upon the ground. Each pedestal, whose weight may amount to 70 tons, is designed to carry a load of the order of 600 tons, the pressure on the soil not exceeding 3½ kilos per sq. cm. The pedestals for Shed J.4, being designed for the lighter load of 300 tons, are rather different, the four inclined struts being replaced by a single post of cruciform section. Moreover, the base block takes the form of an open box, which can be ballasted with broken stone as soon as the pedestal is placed, in order to increase its stability and its resistance to accidental impact from floating craft.

The pedestals are cast in a block-making yard, and after curing are placed in position by means of a floating sheerlegs (see Fig. 6 and Fig. 9) upon the bearing stratum, which has meanwhile been suitably prepared. This preparation consists in removal of mud and sand by dredging down to the hard bottom, then trimming this approximately level, and finally depositing a layer of concrete, which is screeded by a diver.

When the pedestals have been placed they are connected by ground beams of reinforced concrete (J.1 and J.2) or of steel (J.4) likewise placed by the floating sheerlegs, and thus is produced very rapidly the substructure of a shed, upon which the superstructure can be erected immediately without troubling about the filling below.

(d) Superstructure of Sheds

The leading features of construction will be found indicated on Figs. 8, 10, 11, 12. The single-storey Sheds J.2 and J.3 are wholly of reinforced concrete, the mix varying from 300 to 350 kilos of cement per cu. metre of finished work. Shed J.1 being of two storeys, the roof framing is of steel, to lighten the weight, and the roofing is of pumice concrete slabs covered with a layer of asphalt.

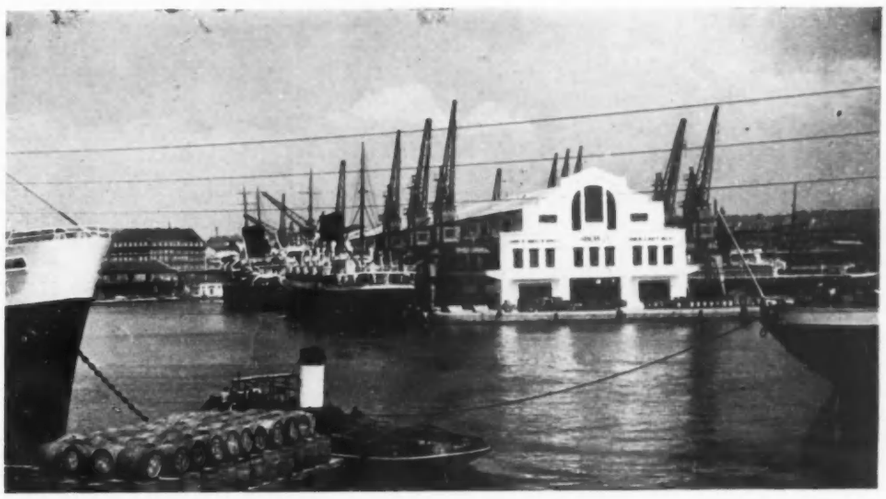


Fig. 15. Shed J 1. View from the Basin.

Sheds J.2 and J.3 have terrace roofs. Floors are all designed to carry a load of 1½ tons per sq. metre, with the addition of 10-ton lorries circulating in the space not occupied by goods. The foundations and stanchions of these Sheds have been made strong enough to carry an upper storey eventually.

Shed J.4 is steel-framed, with only the foundations of reinforced concrete, the roof of reinforced slabs, 3 cm. (1¼ ins.) thick, covered with asphalt. Being only about 22 metres wide, the adoption of steel construction for this shed has enabled all interior columns to be eliminated. The upper floor being accessible to 10-ton lorries and designed for a super-load of 1½ tons per sq. metre, this also is more readily effected in steel than in reinforced concrete. To retard corrosion, use has been made of rust-resisting steel.

The main frames of the sheds are portals hinged at the foot, designed to give only a very limited thrust upon the pedestals, thus accounting for the relative slenderness of the legs. The two pedestals of a pair are connected by a steel tie-beam encased in concrete and supported at the centre on two raking Franki piles, which take up the effect of wind pressure.

The several stages in the process of construction of the eastern part of Shed J.4 were as follows:—

First stage: placing pedestals in position, by floating sheerlegs.

Second stage: placing in position, by floating sheerlegs, of complete portal frame, assembled on land.

Third stage: filling. (Note: The steel tie-beam is so shaped as to give strength to carry the filling wagons before the Franki piles are cast).

Fifth stage: driving the inclined Franki piles and encasing the tie-beam.

(To be continued).

Book Review

Nationalisation of Transport: An Impartial Review with a Foreword by Sir Josiah Stamp (Lord Stamp of Shortlands). Pp. 75. Price 1s. net. London: Modern Transport Publishing Co., Ltd.

So much is being said nowadays about the nationalisation of public utility services, often with only the vaguest idea of all the complicated issues which are involved, that this little brochure dealing with one section, a most important section, of the services in question is very welcome as a fair and carefully-balance statement of the pros and cons of an exceedingly difficult problem. It is easy, as is the practice of many politically-minded agitators, to make sweeping assertions and claims which are not substantiated by facts, and before committing itself to a revolutionary change in transport administration, the nation should assure itself that the change will be for the better. The investigation into the conditions and consequences attaching to the nationalisation of transport in this country enables the reader of the booklet to form a clearer idea of what is involved than he would otherwise be able to do.

There are ten chapters, the first of which describes the scope of the enquiry, followed by one on the criticism of the railways, then by others on a comparison of the case as between road and rail, the value of freedom of choice, the question of efficiency and compensation, the probable advantages and repercussions of nationalisation and the possible disadvantages. The conclusion arrived at in the final chapter is that " the weight of evidence at the present time is clearly against any step in the direction of nationalisation; should conditions change in the future, we may need to revise this conclusion, but in existing circumstances it must stand."

The greater part of the book is concerned with railways and roads. Canals and ports come in for relatively slight notice, but the general argument is applicable in these cases also.

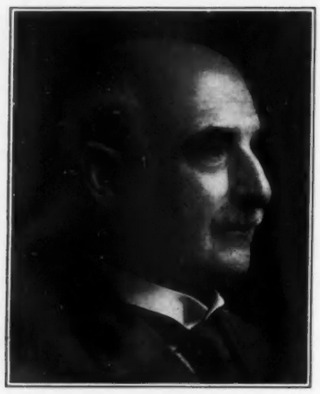
Publications

A copy of a revised report on The Panama Canal and its Ports, published by the Board of Engineers for Rivers and Harbours, War Department, as No. 22 of the Port Series, has been received. The reports in this series cover the principal ports of the United States, and contain information useful to shipping and transportation interests in connection with the movement of goods through the various ports.

We have also received a copy of the Census of Seamen to 15th June, 1937, issued by the Board of Trade (H.M. Stationery Office, 1s. net). The returns relate to vessels registered in the United Kingdom and give the numbers, ages and nationalities of seamen employed, the numbers serving in deck, engine-room and stewards' departments, and other information of a similar character.

Retirement of Port Official

Mr. Christopher Edmund Baldwin, J.P., M.Inst.T., who has just retired from the position of General Manager and Secretary to the Blyth Harbour Commission, Northumberland, had held the appointment since 1909. Within the period of almost 30 years of his service, he has seen, and contributed to, very important developments in the port, including the construction of the West Staiths with a depth of 30-ft. of water alongside at L.W.O.S.T. Coal shipments have increased from four million to six-and-three-quarter million tons per annum and the shipping berths have been augmented from 10 to 13, the newest being equipped with the most up-to-date appliances for coal shipment. He is succeeded by Mr. G. L. Atkinson who has been goods agent at the London and North Eastern Railway Forth Goods Station, Newcastle.



C. E. BALDWIN, Esq., J.P., M.Inst.T.

Port of London Authority

Excerpts from Annual Report

The recently-issued 29th Annual Report of the Port of London Authority covers the period from 1st April, 1937, to 31st March, 1938; 62,645,758 net registered tons of shipping arrived at and departed from the Port during the year under review compared with 52,576,755 tons ten years ago. The tonnage of goods imported during the year was 36,704,160 tons, an increase of 4% over the previous year. Goods exported totalled 7,939,484 tons, an increase of 4.5% over 1937. The total imports and exports together with transhipment traffic, i.e., 44,643,644 tons, was the highest figure ever recorded in the Port of London.

Finance.

The Accounts issued with the Report show the following summary of the year's working:—

	£
Total Revenue	6,132,425
Total Expenditure	4,439,000
Balance of Revenue	1,693,425
Less—Interest on Port Stock and Temporary Loans, Sinking Fund Charges, etc., *less* interest, etc., receivable	1,757,161
Deficit	63,736
Balance brought forward from 31st March, 1937	404,705
Leaving to be carried forward	£340,969

New Works.

Good progress was made during the year with the works included in the first stage of the programme adopted by the Authority in 1936 for the further improvement and development of the Port of London. Among the works actually completed during the year were a specially-equipped berth for the discharge of bananas, the widening of the quay and adaptation of No. 2 Warehouse for the storage of plywood at the Surrey Commercial Docks, electrification of certain quays, the construction of Canary Wharf and other improvements at West India Docks, and the erection of a considerable number of electric cranes. Much of the work of constructing over 3,000-ft. of new deep water quayage on the north side of the Royal Victoria Dock was carried out.

Conservancy.

During the year 1,310,366 cubic yards of mud were removed from the docks and 1,912,598 cubic yards of material were dredged from the river to maintain and deepen the channel.

Forty-four sunken vessels and craft were removed from the river by the wreck-raising plant during the year, viz., three steamers, measuring 10,222 tons in all, 1 motor vessel of 504 tons, 35 barges measuring 2,360 tons and 5 small motor and fishing craft. In addition, 1 steam tug of 28 tons and 5 barges measuring 209 tons were raised in the docks.

General.

The Authority decided as from the 8th October, 1937, to grant exemption from Inward River Duties of Tonnage on vessels with cargo entering the Port to load and not to discharge.

At the request of the Army Council the Authority agreed to co-operate in furthering the expansion of the military docks organisation of the Army Supplementary Reserve, Royal Engineers (Transportation Branch) by inviting volunteers from their staff, including skilled dock workers, and by granting leave facilities for training.

The Report is signed by Lord Ritchie of Dundee, the Chairman of the Authority.

The Proposed Champlain-Hudson Ship Channel

Projects for affording a passage for ocean-going vessels from the Great Lakes of North America to the open sea have been discussed in many forms, the best known being the St. Lawrence Ship Channel in connection with which an International Committee has issued several reports from time to time. An alternative, or more properly, a complementary southerly route is the proposed Lake Champlain Waterway which would connect the St. Lawrence, at or about Montreal, with the Hudson River. This, too, has been the subject of investigation by an International Joint Commission, which has just issued a report of an adverse character, pointing out that the scheme could only be justified, " if at all," as an extension of the St. Lawrence Ship Channel, which is by no means assured, and must in any case require an appreciable period of years to execute and bring into operation. There is the further consideration that, in the meantime, changes in transportation may bring about an entirely different set of conditions, so that it would be premature to discuss the project in detail.

The Commission, however, have considered five different routes for the proposed waterway, as follows:—Route A, from the Beauharnois Canal, just above Montreal across country to a point south of Rouses Point on Lake Champlain; Route B, from the lower end of the Beaucharnois Canal to the town of St. Johns on the River Richelieu; Route C, from Caughnawaga opposite Montreal to Iberville; Route D, from Longueuil, also opposite Montreal, to Iberville; and Route E, from Sorel at the head of Lake St. Peter along the bed of the Richelieu River.

The Commission came to the conclusion that the last-named route, via Sorel, was the most practicable from an engineering standpoint and least impracticable from an economic standpoint. The estimated capital outlay on a 27-ft. waterway is $342,205,000 with annual operation charges of $17,646,400 as against a possible annual saving in transportation costs estimated at $4,710,240.

For a 14-ft. waterway, the annual operating costs would be $2,738,600 and the saving in transportation costs $75,600. For a 12-ft. waterway, the figures are $953,000 and $58,800 respectively.

At the present time, the Richelieu River is navigable, with a depth of 12-ft., from Sorel to the St. Ours Lock, a distance of 14 miles. From the lock to Chambly, a distance of 32 miles, the available depth is 7-ft., but is being increased to 12-ft. In the Chambly Canal for about 11 miles the depth over sills is 6½-ft. and from St. Johns to the International boundary, 23 miles, the depth is 7-ft. From the lower end of Lake Champlain to Albany on the River Hudson, the depth is 12-ft., while in the Hudson from Albany to New York there is a channel 27-ft. deep.

The engineering experts appointed to advise the Commission have given as their opinion that " it is neither advisable nor economically practicable to improve a waterway from Montreal by way of the St. Lawrence and Richelieu Rivers through Lake Champlain to connect with the Hudson River at the present time."

American Association of Port Authorities

Annual Convention

The executive committee of the American Association of Port Authorities have announced that the 27th Convention and Annual Meeting is to be held in the cities of Saint John, New Brunswick, and Halifax, Nova Scotia, from September 12th to September 16th. The first two days will be spent in Saint John, New Brunswick, and the remaining time in Halifax, Nova Scotia. Every opportunity will be given for the inspection of these two modern Canadian ports and an interesting programme has been arranged for the various sessions of the Convention.

As is customary, the Association will welcome to its meeting, all who are concerned with the administration, operation, planning or construction of port facilities, and those also who are commercial users of such facilities. It is the aim of the Association to enlist the aid of all port users and those connected in any way with their development and administration, in an effort to make port services suitable to all needs and impartially fair.

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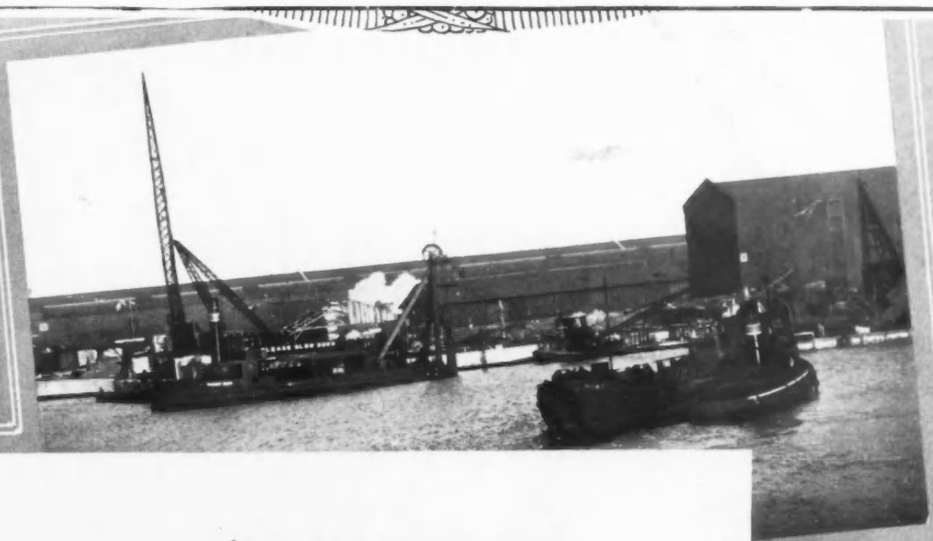

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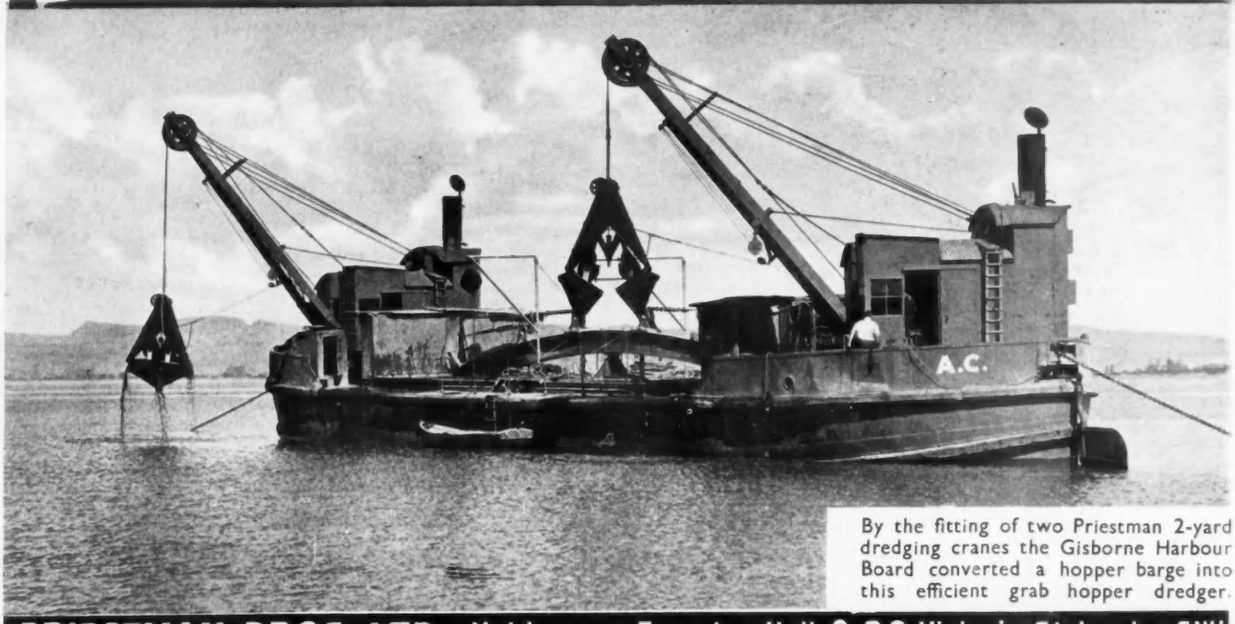

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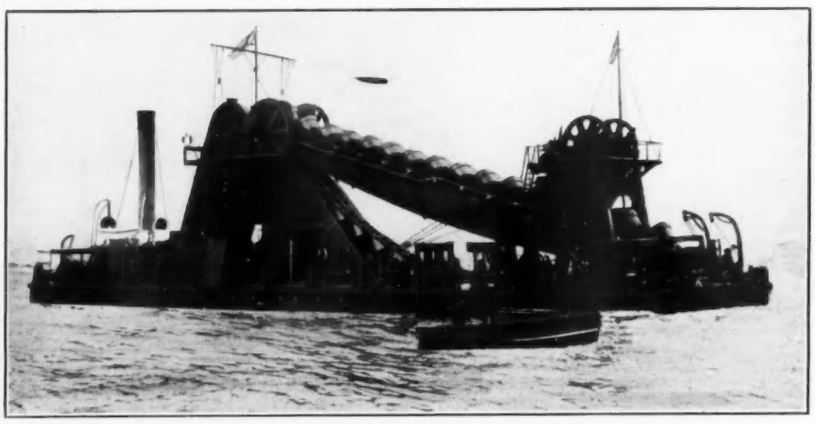

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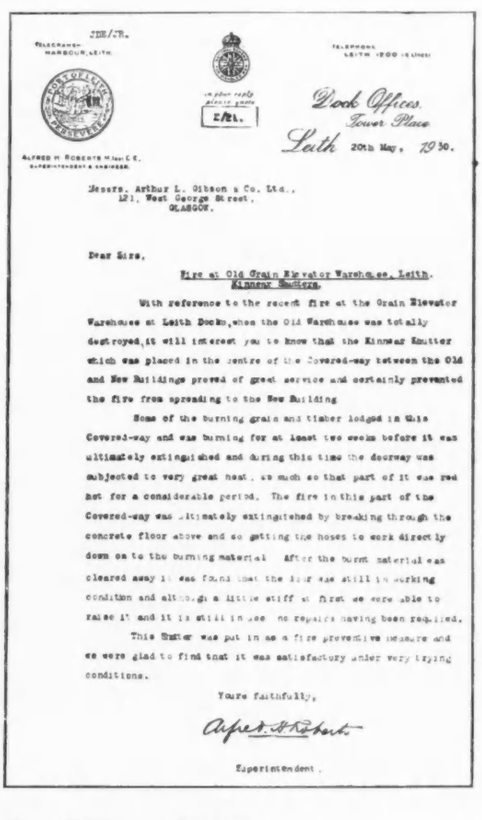

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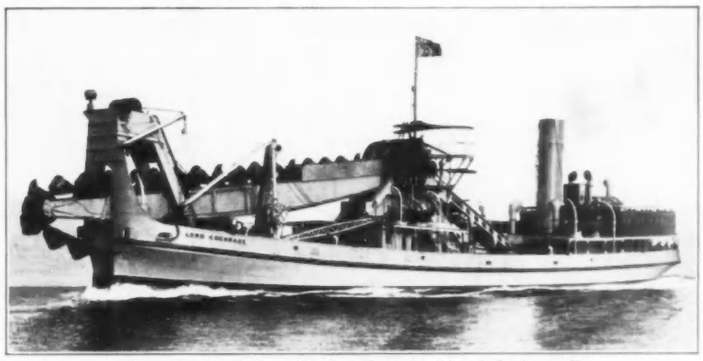

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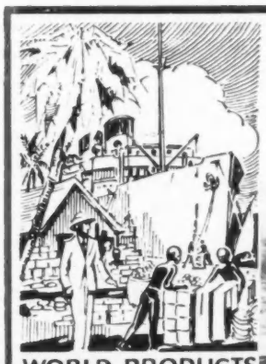

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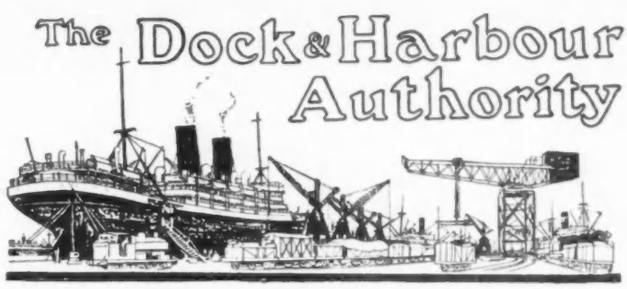

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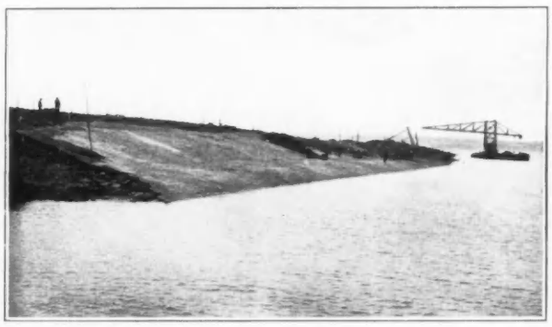

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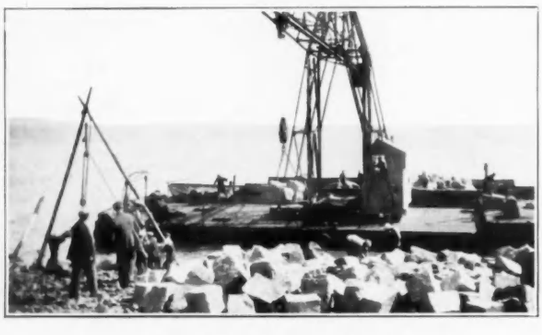

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